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The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication. Such clearance does not necessarily indicate indorsement of the material for factual accuracy or opinion by the clearing agency.

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Described as "revolutionary" is this new design of protective mask developed for military use under the direction of the Chemical Corps and now undergoing tests for adoption. News release about this new mask and also a review of the development of the gas mask are presented in this issue.

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Through editorial oversight the name of the Immediate Past President of A.F.C.A., Rear Adm. N. S. Prime, USN (Ret.), was omitted from the list of national officers, on page 2 of the July-August issue of the Journal and from the listing of the Executive Committee, on page 3.

DIRECTOR-AT-LARGE

Presented here is a picture of Colonel Charles H. McNary, Chemical Corps, one of A.F.C.A.'s twenty Directors - at - Large, elected last Spring. The picture was not received in time for publication with those of the other Directors in the last issue of the Journal. Colonel McNary, at the time of his election, was commanding officer of the U.S. Army Chemical Procurement District, with Headquarters in Chicago. He has since been assigned as Commander of the 81st Chemical Group, Ft. Bragg, N.C.

NEW LIFE MEMBER

On Flag Day, June 14, 1957, Mr. Raymond Franklin Thomasson, a veteran of World War II, with service in the field of Military Intelligence and the 86th Infantry, became a Life Member of the Armed Forces Chemical Association.

Mr. Thomasson is employed as a chemical technician by the Santa Fe Railroad. His home address is 211 Wyoming St., Charleston 2, W. Va.

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We who work *for* you at your National Headquarters would like to work *with* you.

Send us the names of persons whom you have invited to become members of the Armed Forces Chemical Association and who have not accepted your offer. We would like to write a personal letter inviting them to become members. In this way we may work *with* you.

If your friend joins the A.F.C.A. you will have the credit of sponsoring him. Those who sponsor ten new members are eligible to receive a plaque.

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NEW POST FOR GENERAL SAYRE

Brigadier-General Clifford L. Sayre, USAR., senior vice president of A.F.C.A., has been named Director of Central Chemical Engineering for the Chemical Divisions of Food Machinery and Chemical Corporation.

General Sayre has served as Government Research Coordinator for the Divisions since 1955. He will continue to aid in the Government coordination work and supervision of plant location studies.

FORT DETRICK HEARS COL. TOSTI

The Fort Detrick Chapter of the Armed Forces Chemical Association heard Lt. Colonel C. R. Tosti, assistant executive officer at the Air Research and Development Command, Baltimore, at a recent meeting held in the Officers' Open Mess.

Colonel Tosti related the progress of the Air Force aviation and guided missile program to about 50 persons. He was introduced by Colonel John J. Hayes, commanding officer. Colonel Leslie S. Moore, deputy commander, and president of the chapter, presided at the meeting. Dinner preceded the talk.

FIRST NATO REGIONAL MEETING

Mr. Harry A. Wansker (President, New England Chapter, AFCA), President, The Boston Regional Conference on NATO Affairs, organized and brought to a successful conclusion the first meeting of that conference on 22 through 24 March 1957 at the Sheraton Plaza Hotel, Boston, Mass.

The purpose of the conference was to bring together representatives of the NATO nations, business officials and private citizens, so that they might better understand NATO's aspirations and its achievements; and that the public be informed to the greatest possible extent of significant results achieved through NATO consultation.

High ranking military representatives from all of the NATO nations were present and addressed the gathering of Government representatives, business officials and private citizens. The conference included a symposium at Harvard University, a tour of historical sites in and around Boston and concluded with a dinner on Saturday, 23 March, 1957. The master of ceremonies at the dinner was the Honorable Robert Cutler, Special Assistant to the President of the United States and the address was by the Honorable Gordon Gray, Director of Defense Mobilization.

The Commonwealth of Massachusetts, through its legislative bodies, adopted a resolution extending its best wishes for a successful conference.

Mr. Chenery Salmon, also a member of A.F.C.A., was one of Mr. Wansker's principal assistants in the arrangements that culminated in this first meeting to help build a strong and peaceful Atlantic and European community.

MR. LOUIS NEUBERG

Mr. Louis Neuberg, vice president, Food Machinery & Chemical Corporation, with offices in New York City, died suddenly of a heart attack at his home in New Jersey on July 31. Mr. Neuberg had long been connected with Westvaco Chemical Division.

ELEMENT 102 DISCOVERED IN COOPERATIVE EFFORT BY SCIENTISTS OF THREE NATIONS

LEMONT, ILLINOIS—A joint research effort by scientists from the United States, Great Britain and Sweden has led to the discovery of element 102.

The research team included scientists from the Chemistry Division of the U.S. Atomic Energy Commission's Argonne National Laboratory at Lemont, Illinois, the Chemistry Division of the United Kingdom's Atomic Energy Research Establishment at Harwell, and the Nobel Institute for Physics in Stockholm, Sweden.

The new element was produced by bombarding curium, which is element 96, with carbon ions accelerated in the cyclotron at the Nobel Institute.

The scientists who took part in the experiment—the first to lead to the discovery of an artificially created element by an international research team—are:

From Argonne—Paul R. Fields, a group leader in the Chemistry Division, and Arnold M. Friedman, who is working at Harwell for one year under a U.S.-U.K. exchange of nuclear scientists.

From Harwell—John Milsted, a chemist who last year did research work at Argonne, and Alan Beadle, a chemist.

From the Nobel Institute for Physics—Hugo Atterling and Bjorne Astrom, physicists, and Wilhelm Forsling and Lennart Holm, chemists.

The United States provided the very rare isotopes of curium used. It was shipped to Harwell where Friedman, Milsted and Beadle prepared the targets for the experiments. Harwell provided a rare isotope of carbon —carbon-13—used as the bombarding particle. The Nobel Institute provided the cyclotron, some special equipment and a staff of physicists, chemists and technicians. The cooperation with Nobel Institute was started because the cyclotron at the Institute could provide the intense source of high energy carbon-13 ions which were necessary for the experiment.

Experiments were begun in March and first indications that the new element had been discovered were found a few days later. The element was recognized by its unique nuclear properties—half life and radiations—and by its chemical properties. Another series of experiments in April confirmed the original findings. Similar experiments, recently concluded, have again confirmed the discovery.

This isotope of element 102, thought to have an atomic mass number of 253, is very unstable, having a half life of 10 to 12 minutes and emitting alpha particles. The preparation of the element and a study of its properties extends man's fundamental knowledge of matter.

The target material which was bombarded in the cyclotron was in the form of a thin film of curium on an aluminum foil, placed in a specially fabricated probe in order that the recoils from the nuclear reactions could be caught on clean foils and identified rapidly. For the best results, thin organic foils were used as catchers for the recoil atoms. These foils were dissolved in a drop of acetone on a platinum plate, which was flamed to give a thin source for pulse analysis. The platinum plate was treated with hydrochloric acid to put the activity in solution which was then passed through a standardized ion exchange column. Alpha-hydroxyisobutyric acid was used to extract the new element from the column.

—From an A.E.C. Release.

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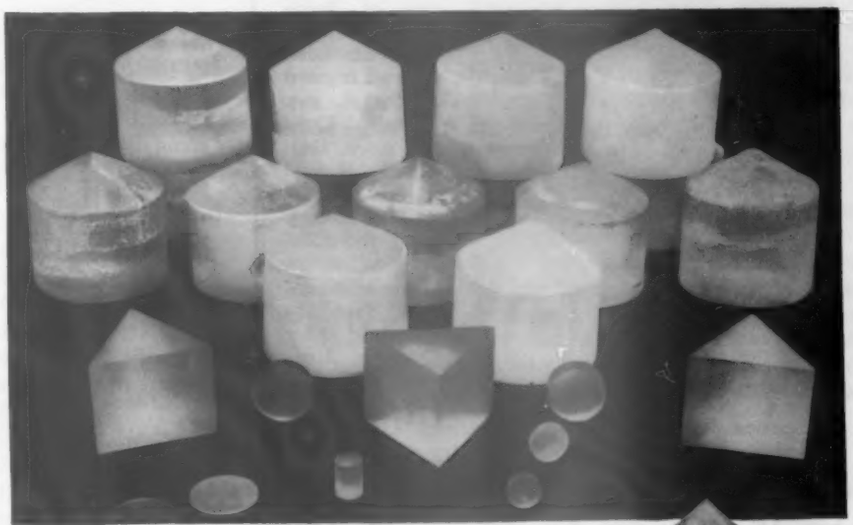

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SEARCHING FOR TOXICOLOGICAL INFORMATION

By Dorothy M. Ward
Chief, Toxicological Information Center
U.S. Army Chemical Warfare Laboratories
Army Chemical Center, Maryland

Worthwhile scientific experiments begin and end with a report. This fact creates a tremendous challenge for the librarian and the information specialist. How well they do their jobs vitally affects research progress.

To emphasize the need of a literature survey before the start of experimentation hardly seems necessary. Aside from avoiding useless duplication of effort, however, a good literature survey may disclose better techniques and methods applicable to the proposed work. Further, a probe into the stockpile of scientific literature may start a chain reaction of entirely new ideas and approaches to the problem at hand, or serve as an impetus for other investigations.

A good literature search is characterized by completeness and accuracy. Completeness is a two-pronged problem, the "open" or published literature, and the unpublished literature, i.e., the laboratory reports both internal and from outside sources which never reach the scientific journals because of security classifications or other reasons. Correspondence and memoranda containing technical data are also considered as unpublished literature.

Miss Dorothy M. Ward, a native of Baltimore, Maryland, has been employed at the Army Chemical Center since 1941. Miss Ward earned a degree in biology from the College of Notre Dame of Maryland, then attended the Catholic University and received a Master of Science degree. Additional postgraduate work included a course in analytical chemistry at the Johns Hopkins University and a course of Special Studies in Genetics at Cornell University. Before coming to Army Chemical Center, Miss Ward was instructor at the College of Notre Dame of Maryland. At Army Chemical Center her work has involved information research and technical editing, making her the logical choice as chief of the newly established Toxicological Information Center.

Miss Ward is a member of Beta Beta Beta, an honorary biological society, and is a member of the Armed Forces Chemical Association.

The accumulation of published scientific data has become overwhelming with the rapid strides made in scientific research and development from the beginning of this century, and especially through the last two decades. In 1907 in the field of chemistry, for example, there were 155 abstractors working on the Chemical Abstracts of the American Chemical Society. By 1953 there were 950 abstractors who covered 5300 periodicals and contributed over 70,000 abstracts each year. Chemical literature in 1953 had increased 147% since World War II (1). In 1956 the annual production of Chemical Abstracts consisted of 80,000 abstracts of papers and 12,000 abstracts of patents. These were gleaned from the systematic examination of 7000 journals and the chemical patents of 18 countries (2). The fourth Decennial Index of Chemical Abstracts, subjects and authors, represent five miles of index file cards (3). In fact, the ready retrieval of this vast amount of information has produced the new science of documentation.

It is not the purpose of this paper to explain all the details and tasks involved in a good literature search, but rather to state, as briefly as possible, some methods which have been employed in answering requests for technical information, especially those pertaining to toxicological research in the Chemical Corps. These requests range from "quickie" types—such as, " a reported LD50 of compound A", to long literature surveys. They may involve only unpublished reports, or open literature, or both.

The realm of the unpublished report propagates more complex problems. The ability to satisfactorily answer a query necessitates the creation of a well-planned subject index system long before the information is sought. Whether mechanical retrieval is employed or whether the index cards are typed, a well-planned subject index will be complete yet succinct, accurate, consistent, and conveniently arranged for quick reference.

If the retrieval of technical information is centered around chemical compounds, one system of nomenclature must be decided upon and adhered to. The American Chemical Society Abstract system is excellent for many reasons. One reason is the employment of "inversion", whereby the most important part of a compound is placed first, denoting the "index compound", while the prefixes denoting the substituents follow (4). This system eliminates scattering throughout the card file.

To illustrate this point let us say that unpublished information is wanted on the biologic effects of organic arsenicals. Reports containing data on diphenylchloroarsine, dichloromethylarsine, diphenylcyanoarsine, besides many other arsenic derivatives would have to be examined. If the compounds mentioned above were indexed as they appeared in reports, the card file would have to be examined for all of these and any other conceivable names. The danger of forgetting "possibilities" is even more serious than the time consumed. Instead, the Chemical Abstracts Index lists these compounds as arsines, and all fall within this large category as: arsine, chlorodiphenyl-, arsine, dichloromethyl-, etc. Again, a search for all possible alkyl and aryl substituents of the carbamates would be very harassing.

When an individual compound is sought, a formula index will serve very well for rapid answers as to the existence of the compound, or to information on

previously assigned nomenclature. A system of arrangement of the atoms must be devised and followed throughout. The Hill system (slightly modified) is used by Chemical Abstracts and is based on an alphabetical arrangement of the elements except that for carbon containing compounds the C always comes first, followed by H if the compound contains hydrogen (5). An interesting deviation from the Hill system has been devised at the Stamford Research Laboratories of the American Cyanamid Company (6). In this system the symbols for carbon and hydrogen are written near the end of the molecular formula. The remaining elements are arranged in sequence based on the Periodic Table, and filed numerically and alphabetically by these elements.

When the staff of a technical information service is small, index completeness may be modified so that the index is slanted to service the particular needs of the individual laboratory or installation. In other words, if the modification insures completeness of subject-matter retrieval as far as the research mission of that laboratory is concerned, then it will be efficient and useful. The subject index of unpublished literature for use by a research scientist engaged in toxicological problems would not need the same compound modifiers as those of interest to a chemical engineer. Both might be interested in corrosion, one in a liver, the other in pipes.

At the Chemical Warfare Laboratories we have selected about thirty "modifiers" for the chemical compound subject index which pertain to the research mission of the Laboratories. The choice was based on the type and frequency of information requested over a five-year period. Sometimes deviation from the selected list is necessary, but every attempt is made to fit the data from the reports into the selected categories.

Let us say that a research laboratory concerned with the biological effects of chemical compounds is on distribution lists to receive unpublished reports from other laboratories engaged in chemical research, pharmacology, and medicine. These reports are received from the library soon after acquisition and 3x5 subject cards are made for each chemical listed. Each compound is appropriately named, and following this name a very precise subheading or compound modifier is added, for example: Arsine, chlorodimethyl-, tox., inhal., rats. We have found this particular breakdown of "toxicity" into route and animal very useful in finding quantitative toxicologic figures for a given compound when the information is needed in a hurry (always) and when large volumes of data refer to the compound.

"Physiologic effects" is another useful compound modifier. If the "effects" are on the nervous system or the heart then "neurolog." or "cardiac" is stated parenthetically after "physiologic effects." These parenthetical qualifications save a great deal of time when very precise information is wanted. They are succinct in that they eliminate such entries as: Methanol, effect on the nervous system. These "effects on" cards become very burdensome.

The subject-index cards should also state the report, its origin, the author, date, file location, and the page number to the particular entry. Cross-reference cards of trivial and trade names to the chemical names are necessary for consistency in nomenclature and the prevention of subject scattering. These cross-reference cards also provide the convenience of ready identification of chemical compounds. If very large quantities of data are to be handled, the possible use of punch card systems and mechanical retrieval methods should be investigated.

Retrieval problems in the published literature do not require as much original planning as retrieval of the unpublished material discussed above. Of course its volume is enormous and a searching task can be very time consuming, but at least the published indexes and abstract journals of this type of documentation help to lighten the burden. Difficulties arise with recent subject matter that has not yet been indexed or abstracted. Reference notes on 5x8 cards made on the current journals as received may be well worth the time spent later on. The librarian may have already done this, and in any event her guidance should be sought.

In between the classified government reports and the journal literature is the category of unclassified documents of federally sponsored basic scientific research. With the support of the National Science Foundation, the Office of Technical Services of the Department of Commerce and the Science Division of the Library of Congress have devised a program to disseminate this information to the individual scientist. This program, known as Government Research Information, will aid the scientist in ascertaining what unclassified reports are being issued in his field of interest. This phase of the Program is offered by the Government Research Information Clearinghouse of the National Science Fundation's Office of Scientific Information. A report-announcement service will be offered on a subscription basis to keep the scientist up-to-date on unclassified government research. Through this announcement he will be able to purchase copies of the listed reports. This second phase is an expansion of a service of several years' standing given by the Office of Technical Services of the Department of Commerce. Finally, through the Science Division of the Library of Congress the scientist will have access to a well-catalogued reference collection of unclassified scientific reports on basic research (7).

The Armed Services Technical Information Agency (ASTIA), established in 1951, provides scientific and technical report services to the Department of Defense and its contractors. ASTIA collects, catalogs, and abstracts technical reports received from all agencies within the Department of Defense and any other reports of interest to the National Defense. Qualified Department of Defense agencies and their contractors may receive abstracts of these reports on catalog cards and they may also borrow entire reports. Upon request ASTIA will compile bibliographies (8).

These abstracting and indexing aids of learned societies, plus the services offered by the government are a boon to the problem of searching for technical information. They certainly ease the task. However, personal resourcefulness, patience, and the critical discernment in selecting technical data are the qualifications essential for ready retrieval. Technical information searching is sometimes frustrating, many times difficult, but at all times rewarding.

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NEW MASK DEVELOPED

Elimination of Canister, Lower Breathing Resistance, Superior Vision, But Full Protection Against CBR Agents in New Design Under Test for Adoption, Army Announcement States.

THE DEPARTMENT of the Army has announced the development of a revolutionary type of protective mask by the Army Chemical Corps with the assistance of the John T. Ryan Memorial Labortory of the Mine Safety Appliances Company, of Pittsburgh, Pa.

The mask, which will undergo final testing, is designed to give the soldier complete protection against the inhalation of war gases, germ warfare agents and airborne radioactive fallout particles. It does not protect against direct radiation.

A major feature of the mask is that it does not have the protruding canister used in current United States and foreign types. This was made possible through development by the Chemical Corps of a new lightweight, pliable gas-aerosol filter material. Pads of this material are enclosed within cavities molded into the rubber facepiece of the mask. Other important advantages of the new mask, the announcement states, are lower breathing resistance, superior vision, better speech transmission and greater comfort.

Production models have been delivered to the Army Chemical Center, Edgewood, Maryland, for final engineering tests, and to the Infantry Board of the Continental Army Command for user tests prior to large scale production.

The mask was conceived and developed under the direction of Major General William M. Creasy, Army Chief Chemical Officer.

EVOLUTION OF THE PROTECTIVE MASK

By MRS. MEIREL K. SALAMON
Chemical Warfare Laboratories
Army Chemical Center

SINCE THE DAYS of the slingshot, each newly developed weapon soon met a countermeasure. More penetrating weapons ultimately brought the full suit of armor; firearms led to heavier armor but resulting loss of mobility caused forged armor's abandonment and combatants then took cover behind trees and walls, in depressed spots in the ground, or in trenches.

During World War I, however, a new weapon was introduced—a weapon which could creep around corners, steal behind walls, and prowl through trenches, unseen and unheard—toxic gas warfare. The first toxic gas attack, directed by the Germans against unprotected Allied troops, caused devastating demoralization. But, by the time the Germans realized the full potential of this new weapon, the Allies had devised a defense.

Just 12 days after the attack, members of the British Expeditionary Force had been issued the Black Veil Respirator, a black gauze rectangle inclosing a thick absorbent cotton pad. The respirator, dipped in a chemical solution, covered the nose and mouth, and was held in place by tapes tied behind the head. The British realized that the veil was not a final answer. Morover, it did not protect against tear gases. Added protection was achieved with a flannel, sack-like helmet, dipped in a chemical solution, and worn with the ends tucked inside the blouse. But its celluloid eyepieces cracked easily, and the lack of an outlet valve permitted a dangerous build-up of carbon dioxide inside the helmet.

Several variations of the helmet were manufactured, until the British turned to an entirely different principle. The new development, called the Large Box Respirator, had a facepiece consisting of multiple layers of chemical-soaked muslin, which covered the nose, mouth and chin. A long rubber tube connected the facepiece to a canister containing granules of charcoal, soda lime and potassium permanganate, and a nose clip and rubber mouthpiece insured that the soldier breathed only that air which entered through the canister. Goggles were worn to protect the eyes.

The Large Box Respirator did not offer complete protection against chloropicrin and, in April 1916, the Small Box Respirator was issued to the British and later to the American troops. The new mask incorporated a smaller canister and a facepiece made of rubber cloth. The nose clip and rubber mouthpiece were retained.

On the entry of the United States into the war, the War Department considered the Small Box Respirator to be the best mask developed by the belligerent nations. However, excessive discomfort caused by the nose clip and mouthpiece precluded the wearing the mask for extended periods. An effort was made to improve the mask, but not until the close of the war was a more satisfactory design developed.

The first United States mask, known as the C.E. (Corrected English), was the same as the Small Box

(Continued on Page 18)

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Readers who have a sharp sense of responsibility to posterity will appreciate this thought-provoking discussion by Admiral Rickover, the eminent naval engineer and atomic scientist, often referred to as the father of the submarine Nautilus, the world's first nuclear powered ship. Others who read the article may acquire such a sense. The article is an address prepared for delivery at the Annual Scientific Assembly of the Minnesota State Medical Association, St. Paul, May 14, 1957, and subsequently released by the A.E.C. for publication. The Journal is pleased to present it in full here as matter of both current interest and lasting value.—Ed.

ENERGY RESOURCES AND OUR FUTURE

By

REAR ADMIRAL H. G. RICKOVER, USN

Chief, Naval Reactors Branch,
Division of Reactor Development
U.S. Atomic Energy Commission
and
Assistant Chief of the Bureau of Ships
for Nuclear Propulsion
Navy Department

—U.S. Navy Photo

I AM HONORED to be here tonight, though it is no easy thing, I assure you, for a layman to face up to an audience of physicians. A single one of you, sitting behind his desk, can be quite formidable.

My speech has no medical connotations. This may be a relief to you after the solid professional fare you have been absorbing. I should like to discuss a matter which will, I hope, be of interest to you as responsible citizens: the significance of energy resources in the shaping of our future.

We live in what historians may some day call the Fossil Fuel Age. Today, coal, oil, and natural gas supply 93% of the world's energy; water power accounts for only 1%; and the labor of men and domestic animals the remaining 6%. This is a startling reversal of corresponding figures for 1850—only a century ago. Then fossil fuels supplied 5% of the world's energy, and men and animals 94%. Five-sixths of all the coal, oil, and gas consumed since the beginning of the Fossil Fuel Age has been burned up in the last 55 years.

These fuels have been known to man for more than 3,000 years. In parts of China, coal was used for domestic heating and cooking, and natural gas for lighting as early as 1000 B.C. The Babylonians burned asphalt a thousand years earlier. But these early uses were sporadic and of no economic significance. Fossil fuels did not become a major source of energy until machines running on coal, gas, or oil were invented. Wood, for example, was the most important fuel until 1880 when it was replaced by coal; coal, in turn, has only recently been surpassed by oil in this country.

Once in full swing, fossil fuel consumption has accelerated at phenomenal rates. All the fossil fuels used before 1900 would not last five years at today's rates of consumption.

Nowhere are these rates higher and growing faster than in the United States. Our country, with only 6% of the world's population, uses one-third of the world's total energy input; this proportion would be even greater except that we use energy more efficiently than other countries. Each American has at his disposal, each year, energy equivalent to that obtainable from eight tons of coal. This is six times the world's per capita energy consumption. Though not quite so spectacular, corresponding figures for other highly industrialized countries also show above average consumption figures. The United Kingdom, for example, uses more than three times as much energy as the world average.

WITH HIGH ENERGY consumption goes a high standard of living. Thus the enormous fossil energy which we in this country control feeds machines which make each of us master of an army of mechanical slaves. Man's muscle power is rated at 35 watts continuously, or one twentieth horsepower. Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men, while at least 2,000 men push his automobile along the road, and his family is supplied with 33 faithful household helpers. Each locomotive engineer controls energy equivalent to that of 100,000 men; each jet pilot of 700,000 men. Truly, the humblest American enjoys the services of more slaves than were once owned by the richest nobles, and lives better than most ancient kings. In retrospect, and despite wars, revolutions, and disasters, the hundred years just gone by may well seem like a Golden Age.

Whether this Golden Age will continue depends entirely upon our ability to keep energy supplies in balance with the needs of our growing population. Before I go into this question, let me review briefly the role of energy resources in the rise and fall of civilizations.

Possession of surplus energy is, of course, a requisite for any kind of civilization, for if man possesses merely the energy of his own muscles, he must expend all his strength—mental and physical—to obtain the bare necessities of life.

Surplus energy provides the material foundation for civilized living—a comfortable and tasteful home instead of a bare shelter; attractive clothing instead of mere covering to keep warm; appetizing food instead of anything that suffices to appease hunger. It provides the

freedom from toil without which there can be no art, music, literature, or learning. There is no need to belabor the point. What lifted man—one of the weaker mammals—above the animal world was that he could devise, with his brain, ways to increase the energy at his disposal, and use the leisure so gained to cultivate his mind and spirit. Where man must rely solely on the energy of his own body, he can sustain only the most meager existence.

MAN'S FIRST STEP on the ladder of civilization dates from his discovery of fire and his domestication of animals. With these energy resources he was able to build a pastoral culture. To move upward to an agricultural civilization he needed more energy. In the past this was found in the labor of dependent members of large patriarchal families, augumented by slaves obtained through purchase or as war booty. There are some backward communities which to this day depend on this type of energy.

Slave labor was necessary for the city states and the empires of antiquity; they frequently had slave populations larger than their free citizenry. As long as slaves were abundant and no moral censure attached to their ownership, incentives to search for alternative sources of energy were lacking; this may well have been the single most important reason why engineering advanced very little in ancient times.

A reduction of per capita energy consumption has always in the past led to a decline in civilization and a reversion to a more primitive way of life. For example, exhaustion of wood fuel is believed to have been the primary reason for the fall of the Mayan Civilization on this continent and of the decline of once flourishing civilizations in Asia. India and China once had large forests as did much of the Middle East. Deforestation not only lessened the energy base but had a further disastrous effect: lacking plant cover, soil washed away, and with soil erosion the nutritional base was reduced as well.

Another cause of declining civilization comes with pressure of population on available land. A point is reached where the land can no longer support both the people and their domestic animals. Horses and mules disappear first, finally even the versatile water buffalo is displaced by man who is two and one half times as efficient an energy converter as are draft animals. It must always be remembered that while domestic animals and agricultural machines increase productivity *per man*, maximum productivity *per acre* is achieved only by intensive manual cultivation.

IT IS A SOBERING thought that the impoverished people of Asia, who today seldom go to sleep with their hunger completely satisfied, were once far more civilized and lived much better than the people of the West. And not so very long ago, either. It was the stories brought back by Marco Polo of the marvelous civilization in China which turned Europe's eyes to the riches of the East, and induced adventurous sailors to brave the high seas in their small vessels searching for a direct route to the fabulous Orient. The "wealth of the Indies" is a phrase still used, but whatever wealth may be there it certainly is not evident in the life of the people today.

Asia failed to keep technological pace with the needs of her growing populations and sank into such poverty that in many places man has become again the primary source of energy, since other energy converters have become too expensive. This must be obvious to the most casual observer. What this means is quite simply a reversion to a more primitive stage of civilization with all that it implies for human dignity and happiness.

Anyone who has watched a sweating Chinese coolie strain at his heavily laden wheelbarrow, creaking along a cobblestone road, or who has flinched as he drives past an endless procession of human beasts of burden moving to market in Java—the slender women bent under mountainous loads heaped on their heads—anyone who has so seen statistics translated into flesh and bone, realizes the degradation of man's stature when his muscle power becomes the only energy source he can afford. Civilization must wither when human beings are so degraded.

Where slavery represented a major source of energy, its abolition had the immediate effect of reducing energy consumption. Thus when this time-honored institution came under moral censure by Christianity, civilization declined until other sources of energy could be found. Slavery is incompatible with Christian belief in the worth of the humblest individual as a child of God. As Christianity spread through the Roman Empire and masters freed their slaves—in obedience to the teaching of the Church—the energy base of Roman civilization crumbled. This, some historians believe, may have been a major factor in the decline of Rome and the temporary reversion to a more primitive way of life during the Dark Ages. Slavery gradually disappeared throughout the Western world, except in its milder form of serfdom. That it was revived a thousand years later merely shows man's ability to stifle his conscience —at least for a while—when his economic needs are great. Eventually, even the needs of overseas plantation economies did not suffice to keep alive a practice so deeply repugnant to Western man's deepest convictions.

It may well be that it was unwillingness to depend on slave labor for their energy needs which turned the minds of medieval Europeans to search for alternate sources of energy, thus sparking the Power Revolution of the Middle Ages, which in turn, paved the way for the Industrial Revolution of the 19th Century. When slavery disappeared in the West engineering advanced. Men began to harness the power of nature by utilizing water and wind as energy sources. The sailing ship, in particular, which replaced the slave-driven galley of antiquity, was vastly improved by medieval shipbuilders and became the first machine enabling man to control large amounts of inanimate energy.

THE NEXT IMPORTANT high-energy converter used by Europeans was gunpowder—an energy source far superior to the muscular strength of the strongest bowman or lancer. With ships that could navigate the high seas and arms that could outfire any hand weapon, Europe was now powerful enough to preempt for herself the vast empty areas of the Western Hemisphere into which she poured her surplus population to build new nations of European stock. With these ships and arms she also gained political control over populous areas in Africa and Asia from which she drew the raw materials needed to speed her industrialization, thus complementing her naval and military dominance with economic and commercial supremacy.

When a low-energy society comes in contact with a high-energy society, the advantage always lies with the latter. The Europeans not only achieved standards of living vastly higher than those of the rest of the world, but they did this while their population was growing at rates far surpassing those of other peoples. In fact, they doubled their share of total world population in the short span of three centuries. From one-sixth in 1650, the

people of European stock increased to almost one-third of total world population by 1950.

Meanwhile much of the rest of the world did not even keep energy sources in balance with population growth. Per capita energy consumption actually diminished in large areas. It is this difference in energy consumption which has resulted in an ever widening gap between the one-third minority who live in high-energy countries and the two-thirds majority who live in low-energy areas.

These so-called underdeveloped countries are now finding it far more difficult to catch up with the fortunate minority than it was for Europe to initiate transition from low-energy to high-energy consumption. For one thing, their ratio of land to people is much less favorable; for another, they have no outlet for surplus populations to ease the transition since all the empty spaces have already been taken over by people of European stock.

Almost all of today's low-energy countries have a population density so great that it perpetuates dependence on intensive manual agriculture which alone can yield barely enough food for their people. They do not have enough acreage, per capita, to justify using domestic animals or farm machinery, although better seeds, better soil management, and better hand tools could bring some improvement. A very large part of their working population must nevertheless remain on the land, and this limits the amount of surplus energy that can be produced. Most of these countries must choose between using this small energy surplus to raise their very low standard of living or postpone present rewards for the sake of future gain by investing the surplus in new industries. The choice is difficult because there is no guarantee that today's denial may not prove to have been in vain. This is so because of the rapidity with which public health measures have reduced mortality rates, resulting in population growth as high or even higher than that of the high-energy nations. Theirs is a bitter choice; it accounts for much of their anti-Western feeling and may well portend a prolonged period of world instability.

How closely energy consumption is related to standards of living may be illustrated by the example of India. Despite intelligent and sustained efforts made since independence, India's per capita income is still only 20 cents daily; her infant mortality is four times ours; and the life expectance of her people is less than one-half that of the industrialized countries of the West. These are ultimate consequences of India's very low-energy consumption: one-fourteenth of world average; one-eightieth of ours.

Ominous, too, is the fact that while world food production increased 9% in the six years from 1945-51, world population increased by 12%. Not only is world population increasing faster than world food production, but, unfortunately, increases in food production tend to occur in the already well-fed, high-energy countries rather than in the undernourished, low-energy countries where food is most lacking.

I think no further elaboration is needed to demonstrate the significance of energy resources for our own future. Our civilization rests upon a technological base which requires enormous quantities of fossil fuels. What assurance do we then have that our energy needs will continue to be supplied by fossil fuels? The answer is—in the long run—none.

The earth is finite. Fossil fuels are not renewable. In this respect our energy base differs from that of all earlier civilizations. They *could* have maintained their energy supply by careful cultivation. We cannot. Fuel that has been burned is gone forever. Fuel is even more evanescent than metals. Metals, too, are non-renewable resources threatened with ultimate extinction, but something can be salvaged from scrap. Fuel leaves no scrap and there is nothing man can do to rebuild exhausted fossil fuel reserves They were created by solar energy 500 million years ago and took eons to grow to their present volume.

In the face of the basic fact that fossil fuel reserves are finite, the exact length of time these reserves will last is important in only one respect: the longer they last, the more time do we have to invent ways of living off renewable or substitute energy sources and to adjust our economy to the vast changes which we can expect from such a shift.

Fossil fuels resemble capital in the bank. A prudent and responsible parent will use his capital sparingly in order to pass on to his children as much as possible of his inheritance. A selfish and irresponsible parent will squander it in riotous living and care not one whit how his offspring will fare.

Engineers whose work familiarizes them with energy statistics; far-seeing industrialists who know that energy is the principal factor which must enter into all planning for the future; responsible governments who realize that the well-being of their citizens and the political power of their countries depend on adequate energy supplies—all these have begun to be concerned about energy resources. In this country, especially, many studies have been made in the last few years, seeking to discover accurate information on fossil fuel reserves and foreseeable fuel needs.

Statistics involving the human factor are, of course, never exact. The size of usable reserves depends on the ability of engineers to improve the efficiency of fuel extraction and use. It also depends on discovery of new methods to obtain energy from inferior resources at costs which can be borne without unduly depressing the standard of living. Estimates of future needs, in turn, rely heavily on population figures which must always allow for a large element of uncertainty, particularly as man reaches a point where he is more and more able to control his own way of life.

Current estimates of fossil fuel reserves vary to an astonishing degree. In part this is because the results differ greatly if cost of extraction is disregarded or if in calculating how long reserves will last, population growth is not taken into consideration; or, equally important, not enough weight is given to increased fuel consumption required to process inferior or substitute metals. We are rapidly approaching the time when exhaustion of better grade metals will force us to turn to poorer grades requiring in most cases greater expenditure of energy per unit of metal.

But the most significant distinction between optimistic and pessimistic fuel reserve statistics is that the optimists generally speak of the immediate future—the next twenty-five years or so—while the pessimists think in terms of a century from now. A century or even two is a short span in the history of a great people. It seems sensible to me to take a long view, even if this involves facing unpleasant facts.

(Continued on page 16)

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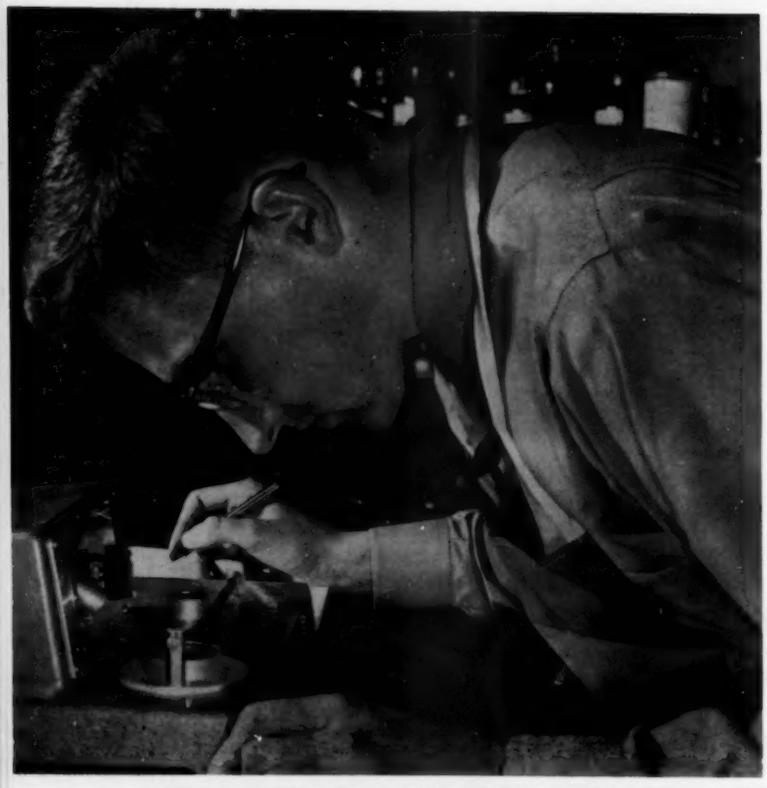
THE SOLDIER CHEMIST

By 1ST LIEUT. FRANK A. JONES, JR.
U. S. Army Chemical Corps

Performing a potentiometric titration.



A laboratory specialist determining the melting point of an unknown substance.

"Prepare a 0.1 normal solution of sodium thiosulfate, Corporal Kane, for a class demonstration tomorrow."

With such an order by the Laboratory Officer, another process is readied for student Chemical Laboratory Specialists* at the U.S. Army Chemical Corps School, Fort McClellan, Alabama. To the students training for the MOS 904.10, this order leads to another analysis—routine now, but possibly critical in the future. These soldier chemists are preparing thoroughly for the "when and if" of chemical, biological, and radiological warfare.

The student arrives at the U.S. Army Chemical Corps Training Command after completion of basic training. Following a thorough orientation on the modern facilities of Fort McClellan, he begins his 8-week course of instruction—his goal, to become a Chemical Laboratory Specialist. To achieve this goal, the student is challenged by a course of instruction 352 hours in length—8 *full* weeks of intensive study and work. In his course he will be faced with the general subjects of intelligence training, chemical warfare, biological warfare, radiological warfare, protection and materiel. His most challenging task, however, is mastering the courses in chemistry and chemical laboratory analytical procedures. The student's task is a tremendous one, considering the technical content of each of these subjects.

The program of instruction is very compact. Coupled very closely with his technical training is the student's military training. The course consists of 5½ weeks of chemistry and laboratory procedures; the remainder of the time is spent on the other subjects.

As a training facility for the student, the U.S. Army

* Prerequisites for the Chemical Laboratory Specialist Course (3-E-5) are a score of 90, or higher, on the general technical aptitude area portion of the Army classification battery, and normal color perception.

Chemical Corps has provided a modern fully-equipped chemical laboratory that is unsurpassed by laboratories of other military installations. The student's first job in the laboratory is to become thoroughly adept in the fundamentals of chemistry. In order to accomplish this, he must master chemical nomenclature, formulas, calculations, equations, and definitions. These fundamentals are taught in the theory portion of the course.

After completing this phase of his course, the potential laboratory specialist is assigned a desk, his "home," for about 3½ weeks. Then, he is issued all of his laboratory equipment (current value $121.07) and is charged with its maintenance.

Practical work now commences. Standardizations, titrations, gravimetric operations, qualitative analyses and special analyses become an everyday thing. Through the performance of these operations, the student puts to practical use all that he has learned. Samples of unknown composition and quantity are issued to him: his job—find out what is present and how much? He discovers that samples are to be weighed with exactness—to a ten-thousandth of a gram, for example, 10.4375 grams of copper sulfate. Always, his aim is ACCURACY. Impregnated clothing is issued to him and his assignment is to determine its protective strength. The completion of all phases of this course rounds out his education as a Chemical Laboratory Specialist; he must be prepared to fulfill his duties in any corner of the world.

Highlighting the course are the last 12 hours of instruction, which is a practical examination. Various samples are issued to the student for this examination, the properties of which are known only to the laboratory instructors. In order to determine accurately such designated properties of the samples as strength, content, boiling point, and melting point, the student may bring to class any reference material needed or may visit the School library for assistance. In this examination, as always, the result of having learned sound laboratory techniques and knowledge of the subject "pay off" for the student. This exercise prepares the specialist for his future role in a Chemical Laboratory Company.

Upon graduation and assignment to a Chemical Laboratory Company, the new laboratory specialist steps into a job filled with interesting challenges ranging from a nerve gas analysis to a canister analysis. To cope with unpredicted tactics of warfare, he may be called upon to conduct research, to improvise, and to prepare field expedients. The specialist fulfills his portion in the overall mission of the United States Army by the accurate and timely data that he provides.

"HUMOR IN UNIFORM" WANTED

WASHINGTON (Army News Service)—Looking for a quick $100 in cash?

Saying it needs short humorous anecdotes of Army life, the Reader's Digest is inviting members of the Army to submit contributions for its well-known "Humor in Uniform" department. The magazine pays a flat $100 for each story accepted.

According to the magazine, contributions must be true, unpublished anecdotes based on service experience, and not more than 300 words long. Contributions, it says, cannot be acknowledged or returned.

Army personnel should mail their anecdotes to Chief, Magazine and Book Branch, Office Chief of Information, Department of the Army, Washington 25, D.C., ATTENTION: Humor in Uniform Editor, Reader's Digest.

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ENERGY RESOURCES

(Continued from Page 12)

FOR IT IS an unpleasant fact that according to our best estimates, total fossil fuel reserves recoverable at not over twice today's unit cost, are likely to run out at some time between the years 2000 and 2050, if present standards of living and population growth rates are taken into account. Oil and natural gas will disappear first, coal last. There will be coal left in the earth, of course. But it will be so difficult to mine that energy costs would rise to economically intolerable heights, so that it would then become necessary either to discover new energy sources or to lower standards of living drastically.

For more than one hundred years we have stoked ever growing numbers of machines with coal; for fifty years we have pumped gas and oil into our factories, cars, trucks, tractors, ships, planes, and homes without giving a thought to the future. Occasionally the voice of a Cassandra has been raised only to be quickly silenced when a lucky discovery revised estimates of our oil reserves upward, or a new coal field was found in some remote spot. Fewer such lucky discoveries can be expected in the future, especially in industrialized countries where extensive mapping of resources has been done. Yet the popularizers of scientific news would have us believe that there is no cause for anxiety, that reserves will last thousands of years, and that before they run out science will have produced miracles. Our past history and security have given us the sentimental belief that the things we fear will never really happen—that everything turns out right in the end. But, prudent men will reject these tranquilizers and prefer to face the facts so that they can plan intelligently for the needs of their posterity.

Looking into the future, from the mid-20th Century, we cannot feel overly confident that present high standards of living will of a certainty continue through the next century and beyond. Fossil fuel costs will soon definitely begin to rise as the best and most accessible reserves are exhausted, and more effort will be required to obtain the same energy from remaining reserves. It is likely also that liquid fuel synthesized from coal will be more expensive. Can we feel certain that when economically recoverable fossil fuels are gone science will have learned how to maintain a high standard of living on *renewable* energy sources?

I BELIEVE IT WOULD be wise to assume that the principal renewable fuel sources which we can expect to tap before fossil reserves run out will supply only 7 to 15% of future energy needs. The five most important of these renewable sources are wood fuel, farm wastes, wind, water power, and solar heat.

Wood fuel and farm wastes are dubious as substitutes because of growing food requirements to be anticipated. Land is more likely to be used for food production than for tree crops; farm wastes may be more urgently needed to fertilize the soil to fuel machines.

Wind and water power can furnish only a very small percentage of our energy needs. Moreover, as with solar energy, expensive structures would be required, making use of land and metals which will also be in short supply. Nor would anything we know today justify putting too much reliance on solar energy though it will probably prove feasible for home heating in favorable localities and for cooking in hot countries which lack wood, such as India.

More promising is the outlook for nuclear fuels. These are not, properly speaking, renewable energy sources, at least not in the present state of technology, but their capacity to "breed" and the very high energy output from small quantities of fissionable material, as well as the fact that such materials are relatively abundant, do seem to put nuclear fuels into a separate category from exhaustible fossil fuels. The disposal of radioactive wastes from nuclear power plants is, however, a problem which must be solved before there can be any widespread use of nuclear power.

Another limit in the use of nuclear power is that we do not know today how to employ it otherwise than in large units to produce electricity or to supply heating. Because of its inherent characteristics, nuclear fuel cannot be used directly in small machines, such as cars, trucks, or tractors. It is doubtful that it could in the foreseeable future furnish economical fuel for civilian airplanes or ships, except very large ones. Rather than nuclear locomotives, it might prove advantageous to move trains by electricity produced in nuclear central stations. We are only at the beginning of nuclear technology, so it is difficult to predict what we may expect.

Transportation—the lifeblood of all technically advanced civilizations—seems to be assured, once we have borne the initial high cost of electrifying railroads and replacing busses with streetcars or interurban electric trains. But, unless science can perform the miracle of synthesizing automobile fuel from some energy source as yet unknown or unless trolley wires power electric automobiles on all streets and highways, it will be wise to face up to the possibility of the ultimate disappearance of automobiles, trucks, buses, and tractors. Before all the oil is gone and hydrogenation of coal for synthetic liquid fuels has to come to an end, the cost of automotive fuel may have risen to a point where private cars will be too expensive to run and public transportation again becomes a profitable business.

Today the automobile is the most uneconomical user of energy. Its efficiency is 5% compared with 23% for the Diesel-electric railway. It is the most ravenous devourer of fossil fuels, accounting for over half of the total oil consumption in this country. And the oil we use in the United States in one year took nature about 14 million years to create. Curiously, the automobile, which is the greatest single cause of the rapid exhaustion of oil reserves, may eventually be the first fuel consumer to suffer. Reduction in automotive use would necessitate an extraordinarily costly reorganization of the pattern of living in industrialized nations, particularly in the United States. It would seem prudent to bear this in mind in future planning of cities and industrial locations.

OUR PRESENT KNOWN reserves of fissionable materials are many times as large as our net economically recoverable reserves of coal. A point will be reached before this century is over when fossil fuel costs will have risen high enough to make nuclear fuels economically competitive. Before that time comes we shall have to make great efforts to raise our entire body of engineering and scientific knowledge to a higher plateau. We must also induce many more young Americans to become metallurgical and nuclear engineers. Else we shall not have the knowledge or the people to build and run the nuclear power plants which ultimately may have to furnish the major part of our energy needs. If we start to plan now, we may be able to achieve the requisite level of scientific and engineering knowledge before our fossil fuel reserves give out, but the margin of safety is not large. This is also based on the assumption that

atomic war can be avoided and that population growth will not exceed that now calculated by demographic experts.

War, of course, cancels all man's expectations. Even growing world tension just short of war could have far-reaching effects. In this country it might, on the one hand, lead to greater conservation of domestic fuels, to increased oil imports, and to an acceleration in scientific research which might turn up unexpected new energy sources. On the other hand, the resulting armaments race would deplete metal reserves more rapidly, hastening the day when inferior metals must be utilized with consequent greater expenditure of energy. Underdeveloped nations with fossil fuel deposits might be coerced into withholding them from the free world or may themselves decide to retain them for their own future use. The effect on Europe, which depends on coal and oil imports, would be disastrous and we would have to share our own supplies or lose our allies.

Barring atomic war or unexpected changes in the population curve, we can count on an increase in world population from two and one-half billion today to four billion in the year 2000; six to eight billion by 2050. The United States is expected to quadruple its population during the 20th Century—from 75 million in 1900 to 300 million in 2000—and to reach at least 375 million in 2050. This would almost exactly equal India's present population which she supports on just a little under half of our land area.

It is an awesome thing to contemplate a graph of world population growth from prehistoric times—tens of thousands of years ago—to the day after tomorrow—let us say the year 2000 A.D. If we visualize the population curve as a road which starts at sea level and rises in proportion as world population increases, we should see it stretching endlessly, almost level, for 99% of the time that man has inhabited the earth. In 6000 B.C., when recorded history begins, the road is running at a height of about 70 feet above sea level, which corresponds to a population of 10 million. Seven thousand years later—in 1000 A.D.—the road has reached an elevation of 1,600 feet; the gradation now becomes steeper, and 600 years later the road is 2,900 feet high. During the short span of the next 400 years—from 1600 to 2000—it suddenly turns sharply upward at an almost perpendicular inclination and goes straight up to an elevation of 29,000 feet—the height of Mt. Everest, the world's tallest mountain.

In the 8,000 years from the beginning of history to the year 2000 A.D. world population will have grown from 10 million to 4 billion, with 90% of the growth taking place during the last 5% of that period, in 400 years. It took the first 3,000 years of recorded history to accomplish the first doubling of population, 100 years for the last doubling, but the next doubling will require only 50 years. Calculations give us the astonishing estimate that one out of every 20 human beings born into this world is alive today.

The rapidity of population growth has not given us enough time to readjust our thinking. Not much more than a century ago our country—the very spot on which I now stand—was a wilderness in which a pioneer could find complete freedom from men and from government. If things became too crowded—if he saw his neighbor's chimney smoke—he could, and often did, pack up and move west. We began life in 1776 as a nation of less than four million people, spread over a vast continent, with seemingly inexhaustible riches of nature all about. We conserved what was scarce—human labor—and squandered what seemed abundant—natural resources—and we are still doing the same today.

MUCH OF THE WILDERNESS which nurtured what is most dynamic in the American character has now been buried under cities, factories, and suburban developments where each picture window looks out on nothing more inspiring than the neighbor's back yard with the smoke of his fire in the wire basket clearly visible.

Life in crowded communities cannot be the same as life on the frontier. We are no longer free, as was the pioneer, to work for our own immediate needs regardless of the future. We are no longer as independent of men and of government as were Americans two or three generations ago. An ever larger share of what we earn must go to solve problems caused by crowded living—bigger governments; bigger city, state, and federal budgets to pay for more public services. Merely to supply us with enough water and to carry away our waste products gets daily more difficult and expensive. More laws and law enforcement agencies are needed to regulate human relations in urban industrial communities and on crowded highways than in the America of Thomas Jefferson.

Certainly no one likes taxes, but we must become reconciled to larger taxes in the larger America of tomorrow.

I suggest that this is a good time to think soberly about our responsibilities to our descendants—those who will ring out the Fossil Fuel Age. Our greatest responsibility, as parents and as citizens, is to give America's youngsters the best possible education. We need the best teachers and enough of them to prepare our young people for a future immeasurably more complex than the present, and calling for ever larger numbers of com-

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petent and highly trained men and women. This means that we must not delay building more schools, colleges, and playgrounds. It means that we must reconcile ourselves to continuing higher taxes to build up and maintain at decent salaries a greatly enlarged corps of much better trained teachers, even at the cost of denying ourselves such momentary pleasures as buying a bigger new car, or a TV set, or household gadget. We should find—I believe—that these small self-denials would be far more than offset by the benefits they would buy for tomorrow's America. We might even—if we wanted—give a break to these youngsters by cutting fuel and metal consumption a little here and there so as to provide a safer margin for the necessary adjustments which eventually must be made in a world without fossil fuels.

One final thought I should like to leave with you. High-energy consumption has always been a prerequisite of political power. The tendency is for political power to be concentrated in an ever smaller number of countries. Ultimately, the nation which controls the largest energy resources will become dominant. If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country.

NEW MASK DEVELOPED

(Continued from Page 8)

Respirator except that the nose clip and mouthpiece had been eliminated, and activated cocoanut charcoal was used in the canister in the place of the British unactivated wood charcoal. Two other masks were designed by the United States prior to the end of the war —the RFK mask and the AT mask. These masks, however, were difficult to manufacture and, just one month before the end of the war, the United States began production of the KTM, or 1919 model, mask. The 1919 model had a facepiece made of a special rubber compound with a layer of stockinette, or thin cotton fabric, vulcanized to the outside surface.

Between the two wars, development work was directed mainly toward improvement of the 1919 model and provision of special-purpose masks.

At the outbreak of World War II, the 1919 model, redesignated M1, was available. But the M1 was still considered unsatisfactory from the comfort angle, and for the amount of time required in the manufacture. The new mask with a fully molded rubber facepiece, known as the M2, was designed and manufactured in large quantities, but it was recognized that a lighter, less bulky mask would be necessary.

Research and development produced the M3, which weighed almost 1½ pounds less than the M2, but this, too, was still heavy and bulky, and difficult to waterproof. The M3, however, incorporated a nose cup which permitted the mask to be worn in sub-freezing weather, and this development has been retained.

Now, for the first time in three decades of development of American military masks, an effort was made to dispense with the hose tube connecting the facepiece and the canister. The M9 mask had the canister mounted on the cheek. The new lightweight canister was made possible by development of a new type of filter, improved charcoal, and by the use of aluminum.

Although the M9 mask is lightweight and comparatively comfortable, it has to be manufactured for right and left-handed personnel because of the protruding cheek-mounted canister.

The Chemical Corps, therefore began research to develop a mask which would have no exterior canister. The result is the E13 (described on page 8).

NUCLEAR RADIATION

BALTIMORE, MD.—Nuclear radiation has been blamed for occurrences ranging from bad weather to headaches. Reports from Germany and Japan indicate considerable popular anxiety over radiation in the atmosphere. In the United States, nuclear bomb tests and radioactive fallout have been blamed for floods, tornadoes, and drought.

It has been found that when people are exposed to environmental conditions which constitute threats to themselves or their important values, certain detrimental changes in their behavior are frequently observed. This is the area of physchological stress. The presence of these threats frequently interfere with effective performance.

Men have long worked in potentially dangerous situations. Yet, despite these potential dangers modern safety practices have reduced the probability of death or injury to very low levels.

The presence of radiation is another potential threat. This may, under certain circumstances, be reduced by the system of health physics monitoring and control. However, the newness of radiation, as compared to heat and electricity, and the fact that it is not detectable by human senses, may give it a peculiar or "mysterious" quality.

In an effort to determine to what extent radiation is considered to be a threat by the individual to his welfare, Dr. Robert G. Smith, Jr., and Dr. John A. Cox, Jr., research psychologists of the Air Research and Development Command (ARDC) conducted a survey of personnel practices in 22 nuclear firms and laboratories.

They found, contrary to popular belief, no organization had more than a minor problem with employees' anxiety over radiation.

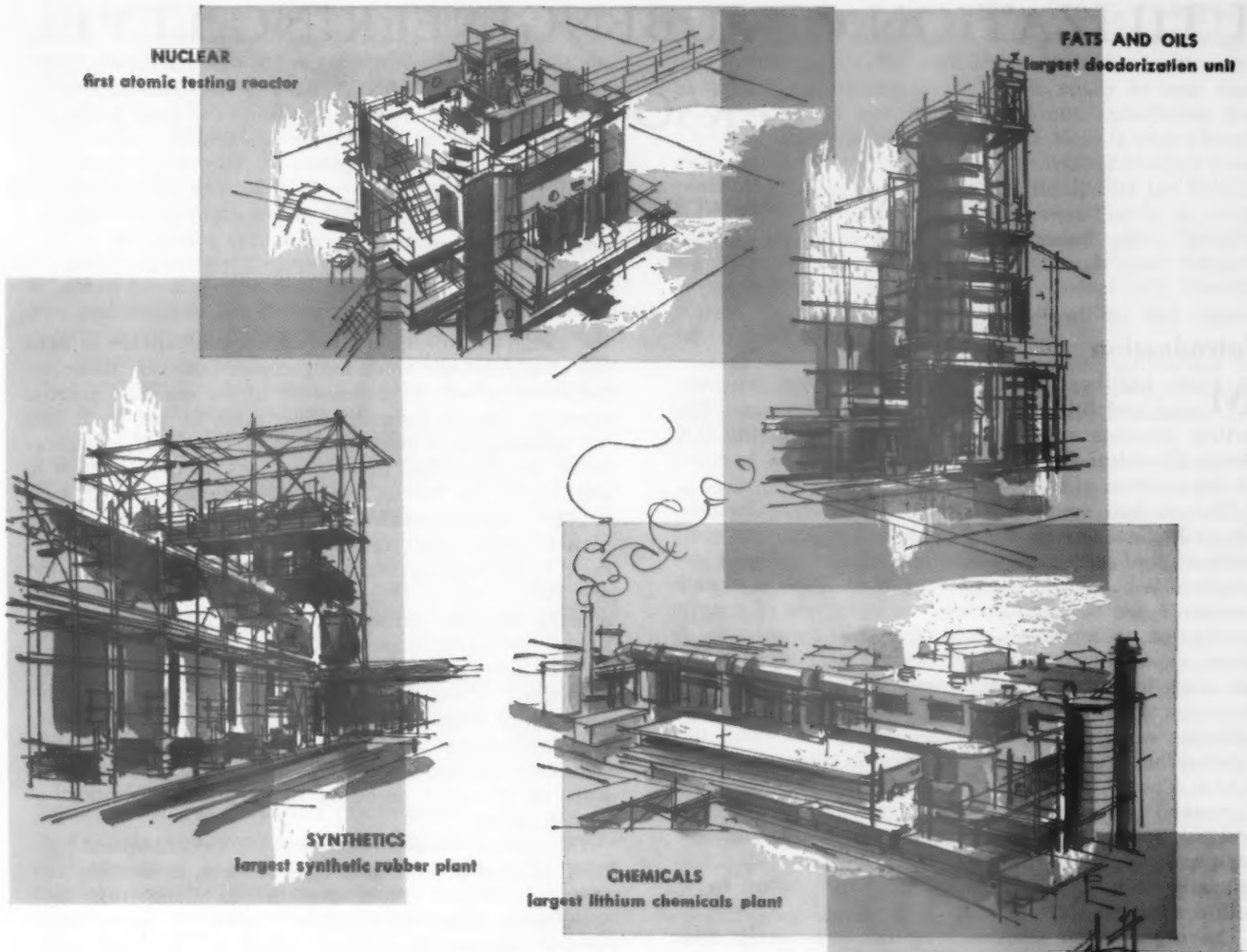
Small firms staffed primarily with technically educated personnel typically had no problems. Larger organizations typically had a minor problem with support personnel who were not so familiar with radiation safety procedures. These included stenographers, janitors, guards, etc.

One common form in which this anxiety was expressed was an attempt to blame radiation for various symptoms which had developed. In some instances, this was said to be encouraged by personal physicians. In *all* cases, however, radiation could be eliminated as a possible cause by means of exposure records maintained for all personnel. In every case, this anxiety problem was relatively minor.

Doctors Smith and Cox found that six of the 22 firms contacted believed that there is a positive appeal to the nuclear field, because of its newness. One firm had a long waiting list for its nuclear-products division.

Based on their survey, Dr. Smith and Dr. Cox believed no special stress problems need be expected in any Air Force nuclear establishment provided radiation levels are below *maximum* permissible exposure rates (Bureau of Standards); that realistic safety indoctrination is provided personnel working in radiation and that a general orientation, emphasizing the precautions taken, is given to other personnel and dependents.

(From ARDC News Release)



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UTILIZATION OF SUBENGINEERING LEVEL PERSONNEL

By DUANE M. KIRKPATRICK and DAVID A. ROSENFELD

U. S. Army Chemical Corps Engineering Command

Introduction

Much has been said and written about the current and future national need for engineers. This article presents a method currently used by the U.S. Army Chemical Corps Engineering Command to assist in the solution of this problem.

The method employed by the U.S. Army Chemical Corps Engineering Command is based on the maximum utilization of personnel whose technical training or experience is below the engineering level. Typical of such personnel are individuals with backgrounds of supply, production, maintenance, field, and shop experience, or those experienced in the supervision of, or planning for, such individuals. Discriminate use of these people increases the effectiveness of enginering organization by relieving engineers of subengineering duties. Such use substantially reduces costs and conserves engineering talent. The U.S. Army Chemical Corps Engineering Command has gained valuable experience under this practice, and presently employs numerous subengineering level personnel. The principles developed for this utilization can well be used by any organization faced with a shortage of engineers.

The organization necessary to utilize properly such subengineering level personnel must be highly flexible and staffed with broadly experienced workers and supervisors. The latter must be capable of evaluating varying capabilities and training subordinates when required, and able to lay out definite plans to utilize such personnel to the best advantage.

Coordination of efforts of the engineers and subengineers must be carefully controlled. Working relationships and flow of work must be specifically directed. Only when such coordination is accomplished will this concept work.

The approach to this utilization of personnel is based on the evaluation of an individual worker's capabilities, which, at this level must take into consideration not only the sum total of job knowledge and practical experience, but also the potential which may exist through the individual's hobbies, home study, native intelligence and the like. At times, this evaluation is unconsciously developed by a supervisor who becomes aware of the potential of a subordinate through periodic talks, association, unique assignments and similar contacts. However, when accomplished in this fashion, the evaluation is not necessarily applied to all personnel—rather only to those lucky few who are the more articulate or self-confident. A planned study of potential will consider all personnel and will demonstrate or bring to light the true capabilities of a working group.

Problems and Recommended Solutions

The primary problem in an organization which utilizes technical personnel below the engineering level, as previously mentioned, is the determination of the range of duties such personnel are capable of performing. Jobs and work assignments based on these capabilities within the framework of the assigned mission must be clearly defined. Limits must be set forth that are reasonably within the scope of personnel qualifications. In effect, this process enables an organization to exploit to the fullest extent the capabilities of subengineering personnel. When the levels of performance of a working organization are established, the assignment to subengineering personnel of levels of work that are below the strict requirements of bona fide engineering releases comparable man-hours of engineering talent for more important assignments. Obviously, a careful survey and analysis of existing and potential workloads is required before such pre-planned work distribution will function to advantage. Responsibility for completion of the work should be given with the assignment. Indiscriminate application of engineering review to all work accounts for a good percentage of wasted talent.

The prevention of monotony, with its consequent lowering of morale and unit effectiveness, is another important problem. Monotony breeds disinterest and resentment, thus reducing production. It is an ever-present problem in an organization staffed with technicians of subengineering status. Utilization of such skills as are possessed by these men tends to boil down to giving the same job to the same man constantly—until the drop in performance efficiency is of such magnitude that it can no longer be ignored. The obvious and simple answer to this problem is the variation of work assignments. Such variation must be consistent with the workload and the individual's capabilities. However, careful planning is necessary to prevent over-variation with its accompanying drop in efficiency. Assignments must be balanced to provide the proper amount of variation without adversely affecting production.

The third major problem is the training or "breaking in" of personnel on new or changing jobs. Any training plan must take into consideration the individual's background and performance and must be designed to broaden and develop both by existing talents and potential talents. It is at this stage that full and effective utilization of personnel is either realized or lost. A physical listing of capabilities and potentials, matched against objectives to be realized, greatly assists in this task. Throughout the period of training, regular checks of progress, matched against this original list, will indicate the probable eventual success or failure of the training method. A properly planned training program geared to fit the individual's background will assure a successful and smooth transition into the new job.

A Practical Organization for Utilization

Organization for the utilization of the subengineering level personnel requires the considered choice of qualified personnel for supervisory positions

It is requisite, of course, that the supervisor's background be such as to qualify him to absorb new concepts readily, to recognize problems and formulate solutions quickly and accurately, and to adapt to new and changing programs easily. He must also be qualified, in the light of previous discussion, to evaluate potentials and capabilities, to recognize limitations, to train, to instruct, to inform, and to establish effective communication between management and technician.

It is the direct responsibility of top management to keep the supervisor informed of changing conditions and to afford him the opportunity of broadening his perspective and background through awareness and analysis of both current and anticipated problems and workloads. An informed supervisor can accomplish training, planning and production duties in a manner far superior to that of an uninformed supervisor.

Substantially, the physical organization for full utilization of subengineering personnel should be simple and direct. Lines of authority should be clean-cut, responsibilities clearly defined, and the numbers of supervisors and "staff" positions carefully controlled. The variety of job titles should be kept to a minimum to permit variation of assignments and more effective support of the engineering staff. Sufficient authority should be given to "line" supervisors to permit close and positive control of personnel, assignments and schedules. Such organization encourages the practical approach to problems rather than the theoretical approach. A practical approach is mandatory for efficiency in this organization.

Specific Methods and Procedures

Methods and procedures developed to govern the operations of personnel who lack engineering status and who have had little or no formal professional training, must differ in some respects from the methods and procedures governing the operations of engineers. Within an engineering organization, the same methods cannot be applied across the board to engineer and subengineer alike. But it is obvious that *entirely* different methods cannot be used. For the sake of consistency and efficiency, to promote an even, continuous flow of finished work and to allow maximum coordination of effort, the methods and procedures must have a common base.

To accomplish the utilization of personnel who are not engineers and yet to integrate them fully into the organization, realizing the benefits of their potential, a modification of the scope and technical aspects of engineering methods and procedures, tailored and geared to fit the needs of the subengineering group, offers the best approach.

In this program, a positive approach is necessary to insure success. An actual step-by-step analysis of every task performed by the engineers in an organization is the logical starting point for establishing assignments. Every task that consumes any part of an engineer's time must be listed. A series of studies extending over a period of days, sufficiently long to assure inclusion of the variety of tasks actually accomplished by engineering personnel, will provide the necessary listing. The next step is an analysis of the listing—looking for any task which can conceivably be handled by subengineering personnel. A fresh outlook is required in this analysis —the domain of the engineer has been so firmly intrenched in people's minds that any technical problem is automatically assigned to engineers for solution. Now, in this analysis, previous concepts must be set aside and every task challenged: "Can anyone other than an engineer do this? Can it be modified to allow a subengineer to do it? Can a subengineer do any part of it?" Where the answer is yes, the task is set aside for assignment to the subengineering group. It can easily be seen that this analysis, if properly carried out, establishes the extent of the benefits to be realized. Here is where management and the engineer must be willing to alter their concepts. The engineer must not think that his field is being invaded. Rather, he must realize that he is being assisted—freed to do more engineering, more creative thinking—to advance in his field through more concentrated use of his talents. Such a concept will literally "push" the engineer ahead—in both ability and opportunity.

With the list of tasks which can be performed by subengineers, and with a knowledge of the capabilities and potentials of such personnel, specific methods and procedures can be developed.

Present organizational engineering methods should be reviewed, brought up to date, streamlined and given a general overhauling. Thus, keeping in mind the needs of the subengineering personnel, the engineering methods could be modified, where required, to adapt them to broader use. In modifying the methods to allow subengineers to use them, it is important to keep the basic concept of the method intact, for from his adaptation of method comes one of the most important benefits of the utilization of subengineering personnel. This is the training of such personnel in engineering methods—a progressive event that brings the subengineer into the field of engineering in such a way that individual talent can be developed and totally utilized by supervisory personnel. It is reasonable to assume—and it has occurred—that personnel who work with engineers receive progressive training in engineering. With sufficient training of this sort, they may accomplish certain engineering tasks, and further relieve man power shortage.

Current Adaption

The U.S. Army Chemical Corps Engineering Command is presently using subengineering personnel to conserve engineering talent, to minimize recruitment difficulties and to alleviate the general shortage of engineers.

Specifically, the personnel whose training is technically below the engineering level have been utilized in the Federal Cataloging Program and in Products Engineering. Much of the program is based on use of engineering procedures and concepts, modified in such manner to permit the use of subengineering personnel. This course has proved successful. When portions of the Department of Defense Standardization mission were assigned to the U.S. Army Chemical Corps, a decision was made to utilize these personnel to the fullest extent. A study of the exact task and duties required by the Defense Standardization Program indicated a number of duties which could be performed by subengineering personnel. A pilot unit composed of such personnel was activated, and following thorough analyses of their backgrounds, a specific mission was assigned this unit. Knowledge of the individuals' backgrounds and potentials facilitated the training and transition of this unit into the full range of standardization duties assigned it.

On the basis of past experiences and with full knowledge of workloads ahead, it is believed that employment of subengineering personnel by the U.S. Army Chemical Corps Engineering Command will conserve many man years of engineering talent and yet expeditiously accomplish its mission.

The Case of the ALUMINUM-COVERED MOUNTAIN

By EUGENE P. SMITH
Assistant, Supply Division
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(Author tells of money-saving replacement of traditional canvas covering for outdoor storage of Army equipment by aluminum covered sheds.)

Moving mountains is never an easy job, but it's a task the Army frequently has to perform. Often vast quantities of material must be moved great distances. Many complex problems are involved in the transportating of military supplies and equipment to areas where they are needed—but that's only half the story. When the goods are delivered, a whole Pandora's box full of new problems pops open. These mountains of material must be stored and protected against loss, damage, theft, and a host of other expensive enemies.

Storing mountains is another one of the Army's jobs. This can be a costly operation, especially when the goods are stored out of doors. Like all costs, this one must be reduced to that optimum level where efficiency and cost combine properly. Optimum cost is a goal which the Chemical Corps strives to attain in all its operations. In the field of outdoor storage, the Chemical Corps has made strides recently in reducing costs to a level which should please Uncle Sam and the taxpaying public, as well as increase the efficiency of the Chemical Corps supply activities. Here's how it happened:

Problem of War Accumulation

Following World War II, the Chemical Corps faced tremendous materiel storage problems. Production was geared to war needs, not to storage capacities, and finished materiel was rolling off production lines in large volumes on V-J Day. America's vast industrial machine could not be stopped on a dime, and when war production was halted, huge quantities of equipment and supplies were on hand. In this country, enroute overseas, and in foreign storage areas were large amounts of materiel the Army considered good enough to keep, in case of emergency. Mountains of valuable supplies and equipment had to be stored under conditions that were far from ideal.

At Rocky Mountain Arsenal in Denver, Colorado, for example, tons and tons of stocks were on hand. Storage facilities consisted of acres of ground and a considerable quantity of tarpaulins; so ground storage under tarps became the order of the day. Gravel pads and light wood frames for the tarps helped somewhat, and for a time, this solution to the storage problem looked good.

As time wore on, however, so did the tarpaulins. Occasional gales, snowstorms, and hailstorms damaged the covering, and soon it became necessary to replace most of the tarps. As the covering was replaced, improvements were made. Sturdier frames were constructed. Yard-wide canvas strips replaced the tarpaulins and saved a few dollars. Some canvas was treated with water-proofing which seemed to help weathering properties, but this made the material less pliable and more likely to tear. Treated or untreated, tacked or sewed in tarps, the covering could not be made to last much more than three years. Storage costs were sky-high!

A particularly destructive hailstorm that tore thousands of yards of canvas to shreds made it obvious that a better solution had to be found. About this time, pioneering work was begun by the Chemical Corps that ultimately led to the development of a low-cost, standardized type of protective covering.

Arsenal Applies Farm Shed Idea

Instead of an engineering study, the people at Rocky Mountain Arsenal took a more down-to-earth approach. It was remembered that farmers often whack together frame structures and cover them with metal sheathing to form a useful shed that lasts for years. Why

Corrugated Aluminum Sheds for Chemical Corps depot storage found more efficient and less costly than canvas paulins.

Interior view of Aluminum Sheet Storage Shed of earlier type with wood frames.

—U. S. Army Photos

wouldn't the same idea do the job that had to be done at the Arsenal?

Before permission was given to proceed with development, some convincing had to be done. Authorization needed something better than rubber legs to stand on. The painful experiences with existing coverings plus "guesstimates" on costs of untried alternates, swung the balance in favor of the new idea.

At the time, replacement of unserviceable covering was costing the government about twenty-seven cents per square foot for the cotton duck material, plus cost of transportation from the source depot to Denver. On top of this was the cost of labor to remove the old and install the new canvas. Total material and labor cost for replacement alone came to about thirty-five cents per square foot. And replacement was necessary every three years!

Corrugated aluminum ran about eleven cents per square foot, and galvanized steel slightly less, as compared with the twenty-seven cent figure for the cotton duck. Also, metal sheeting could be expected to last longer than the canvas, if properly installed. On the basis of these facts and figures, plans were developed that pointed to the use of corrugated aluminum over a wood frame. Aluminum was favored over steel because of its inherent weather resistance without any coating or preservative, and its ease of fabrication and handling.

Aluminum Covering in Test Shelter

Construction of a pilot test shelter was authorized. The first aluminum covered shelter for the Chemical Corps used standard-dimension lumber. Walls and roof were not sheathed completely, as in construction of a house. Only a skeleton frame was provided over which the aluminum could be fastened.

The shelter was sixteen feet wide, about eight feet high to eaves, had a gable roof, and was about 150 feet long. It was built on a gravel pad in an open storage area, and the frame was anchored about every fifteen feet by wiring to steel rails buried a few feet in the ground.

The size initially chosen accommodated storage of bomb clusters. It permitted access for shipment by removal of roof sections without damaging the shelter. Replacement of the roof was accomplished with the same aluminum and lumber, thus minimizing loss of materials. The structure could be built over supplies already stored. Of course, storage stacks had to be properly planned within dimensional limitations of the shelter design, and in conformance with aisle space and drainage requirements.

Additional shelters were approved and built for bomb clusters at Rocky Mountain Arsenal, Deseret Chemical Depot, and Pine Bluff Arsenal. Refinements in structural features approved in December, 1952, included fabrication of the shelters in demountable sections, similar to the idea of the packaged house. The walls, ends, and roof section were designed to permit construction or disassembly using unskilled labor.

Industry Extends Helping Hand

In 1955, the Deputy Chief of Staff for Logistics published a policy directive that required the use of non-combustible material for shelters. Lumber for frame-work was thereby eliminated, and the design was changed to sectionalized all-metal construction. Interested industry contributed realistic advice in the development of this improved shelter construction, and shelter sections were fabricated by industry on contract basis to provide for needed shelters. Thus, teamwork between the Chemical Corps and industry produced an improved solution to the problem, and benefitted both parties.

The type of construction of transitory shelters in use today is an improvement over the one pioneered by the Chemical Corps. Still of prime importance, however, is the basic purpose of the original shelter: to provide less costly, more durable protection for large quantities of supplies which cannot be economically protected and stored by use of tarpaulins, magazines, igloos, or other means.

At least one other Technical Service has indicated interest in the type of shelter built by the Chemical Corps. This discussion has been offered in the hope that services not now using this type of low-cost shelter can put the idea to work saving dollars for the taxpayers of America.

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FIELD SAMPLING AND ANALYSIS OF NERVE GAS*

By

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and
JOSEPH EPSTEIN
CHEMICAL WARFARE LABORATORIES
Army Chemical Center, Maryland

IT IS WELL KNOWN that the Chemical Corps is vitally concerned about the defense against large scale uses of nerve gases. As a result, various types of protective and detecting devices have been developed and are continuing to be developed. In order to aid in the development of these devices, the behavior of the nerve gases under various meterological conditions must be studied in great detail. Questions such as these must be answered:

What concentrations can be expected under an attack of nerve gas?

How well will our protective devices serve us?

Are we capable of detecting sub-lethal as well as lethal concentrations in the field?

To answer these questions, we have established at Army Chemical Center extensive test fields equipped with many varieties of field sampling devices and meteorological instruments to study the behavior of nerve gas clouds.

In the development of field sampling and analysis techniques, the problems confronting us were quite different from those found in devising a laboratory procedure. Rigorous field requirements had to be satisfied before a scheme or technique could be adopted for field use. For example, the procedure has to be sufficiently sensitive so that sub-lethal concentration could be detected and engineered so that as many as 2000-3000 samples could be analyzed in a short period of time. Another example concerns the sampling device and the absorbent contained therein. The device had to withstand all sorts of weathering conditions, such as dry, hot sun, rain, cold, and freezing temperatures. The absorbent, in particular, could not radically change physically nor could it be affected chemically by the adverse conditions.

The purpose of this paper is threefold: 1. To present the criteria for selecting absorbents. 2. The effect the absorbent has on analytical procedures and sensitivity, and 3. To show the various devices used in the field sampling.

The absorbent selected for field sampling will depend upon the method of analysis to be employed.

As for example, if interest lies in detecting "active" nerve gas, the more specific type of analysis as the Schoenemann reaction is chosen as the method, and the liquid absorbent would be generally organic in nature (Figure 1).

* Presented before the Air Pollution Symposium at the Atlantic City Meeting of the American Chemical Society, September 1956.

SCHOENEMANN REACTION

NERVE GAS

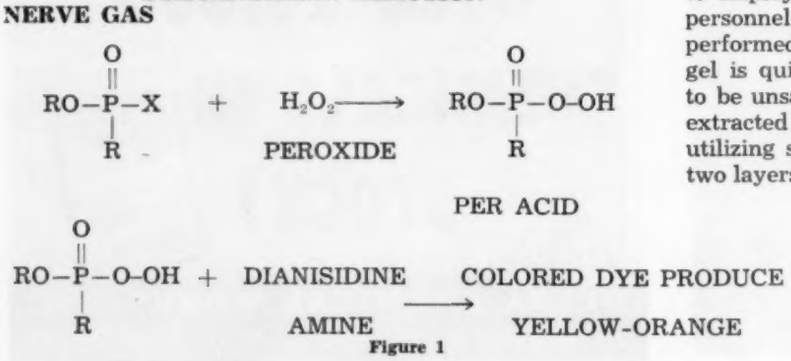
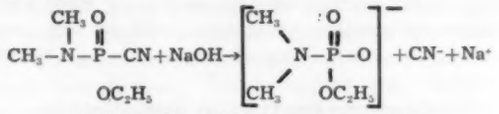


Figure 1

On the other hand, if it is desired to estimate concentration of nerve gas by the phosphate, fluoride or cyanide analyses, then a reacting type of absorbent is used, namely 2% aqueous sodium hydroxide (Figure 2).

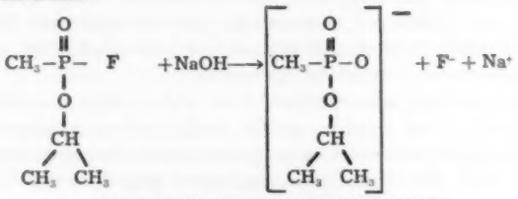
REACTION OF NERVE GASES WITH 2% AQUEOUS CAUSTIC

GA TABUN



DIMETHYLAMIDO PHOSPHORATE

GB SARIN



ISOPROPYL METHYLPHOSPHONATE

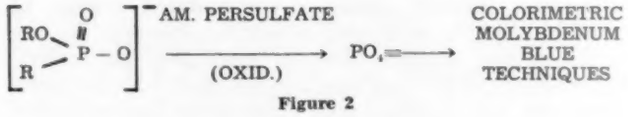


Figure 2

Various types of absorbents have been investigated. Solids such as silica gel and activated charcoal, as well as liquid absorbents, have been used successfully on sampling nerve gases. Although the solid absorbents are highly efficient in collection, the great disadvantage in their use is that the nerve gases are not stable on the absorbent for any reasonable length of time (greater than 24 hours). When large numbers of samples await analysis (2000 to 3000), it becomes extremely impractical to employ these absorbents due to the limited time and personnel factors. However, where the analysis can be performed within a 24-hour period after sampling, silica gel is quite satisfactory. Activated charcoal was found to be unsatisfactory because the nerve gas could not be extracted efficiently from it. A technique was devised utilizing silica gel sandwiched in some device between two layers of filter paper (Figure 3).

The discs shown as A1 and A2 are filter paper. A3 is a cardboard spacer and A4 is 120 mg. of 40-60 mesh silica gel. B1 and B2 show the sandwich partially completed and C, a completed sandwich. The layers are held together with a small amount of acetone soluble Duco cement.

In the lower portion an exploded view of a completed field sampling assembly is shown. One (1) is the female section of the holder into which the sandwich (2) is placed. An additional spacer (3) is added before the male section (4) is turned into place. A critical orifice (5) is attached with rubber tubing to maintain uniform sampling flow rate of 1 liter/min. After sampling, the sandwich is dropped into a known volume of absorbent, acetone, for extraction and analysis by the Schoenemann reaction. The stability of the nerve gas (Sarin) on the gel can be increased by pre-impregnating the gel with a solution of potassium dihydrogen phosphate adjusted to pH of four with phosphoric acid.

We would now like to turn to a discussion of liquid absorbents used in conjunction with the Schoenemann reaction. There are many factors governing the selection of a field sampling absorbent (Table I).

TABLE I

Factors Governing The Selection of Field Sampling Absorbents

1. SUNLIGHT EFFECTS
2. SLIPPAGE
3. ANALYTICAL SENSITIVITY
4. STABILITY OF NERVE GAS
5. PHYSICAL CONSTANTS
6. TOXICITY
7. PURITY
8. COST
9. MISCIBILITY WITH WATER

The first four are the more significant. The remaining five are important but play a secondary role in the selection.

Absorbents which have been tested are listed in Table II.

TABLE II

ABSORBENTS USED IN SAMPLING NERVE GASES

ACETONE

CH_3COCH_3

DOWANOL 50B

(DIPROPYLENEGLYCOL METHYL ETHER)

$CH_3-O-C_3H_6-O-C_3H_6-OH$

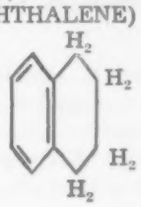
ISOPROPANOL

$CH_3HCOHCH_3$

DIETHYLPHTHALATE

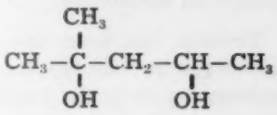
TETRALIN

(1, 2, 3, 4 TETRAHYDRONAPHTHALENE)

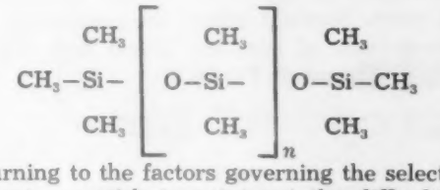


HEXYLENE GLYCOL

(2 METHYL 2, 4, PENTANEDIOL)



SILICONE 2 (DOW CORNING 200 FLUID)



Returning to the factors governing the selection of an absorbent, we wish to point out the difficulties which were encountered. The advantages and disadvantages in the use of the various absorbents are given in Table III.

TABLE III

PRIMARY CRITERIA FOR SELECTION OF FIELD ABSORBENTS

ABSORBENT	SUNLIGHT EFFECTS	ABSORPTION EFFICIENCY	ANAL. SENS.	AGENT STABILITY	USE
ACETONE	NONE	**POOR** HIGH VOLATILITY	GOOD	FAIR	LABORATORY SAMPLING SHORT TIMES
ISOPROPANOL	NONE	**POOR** HIGH VOLATILITY	GOOD	GOOD	LABORATORY SAMPLING SHORT TIMES
TETRALIN	NONE	GOOD	**POOR**	GOOD	CHAMBER & LABORATORY REQUIRES PURIFICATION BEFORE USE
SILICONE 2	NONE	**POOR**	**POOR**	EXCELLENT	NOT USED
DOWANOL 50B	**YES** HIGH BLANKS	GOOD	GOOD	GOOD	PURIFICATION REQUIRED LIMITED FIELD USE PROTECTION OF SAMPLES NECESSARY
DIETHYLPHTHALATE	**YES** HIGH BLANKS	GOOD	GOOD	EXCELLENT	PURIFICATION REQUIRED LIMITED FIELD USE PROTECTION OF SAMPLES NECESSARY
HEXYLENE GYLCOL	NONE 30 DAYS	GOOD	EXCELLENT	GOOD	FIELD & LABORATORY USE

Sunlight effects can produce serious errors in the analyses. High analytical blanks are obtained in the Schoenemann reaction whenever certain absorbents are exposed to sunlight.

The sunlight effect produced by diethylphthalate (DFP) and Dowanol 50B may be due to a photochemical production of peroxides which in themselves are strong enough to oxidize the amine (o-dianisidine) to the characteristic color.

Thus, in the screening tests of candidate absorbents, those which produce this undesirable effect are eliminated immediately.

Acetone and isopropanol have been used in many laboratory studies involving short time sampling. They are, however, unsuited as field absorbents due to their relatively high volatility when long time sampling is required. No sunlight effects are obtained with these absorbents. Silicone gave no sunlight effects but was discarded because of low absorbent efficiency and low analytical sensitivity.

Tetralin has been successfully used in sampling of nerve gas in chamber work. The unique feature in this technique lies in the heating of the reaction solution to accelerate the color formation. Sunlight effects are nil. However, it does not lend itself to be a field absorbent because, as reported, tetralin required vacuum distillation before use. Hexylene glycol, recently investigated in detail, was found to be satisfactory for all nine factors and was finally adopted as the standard field absorbent for nerve gases. Sunlight effects are completely eliminated. Comparison of hexylene glycol with DFP and Dowanol 50B, is shown in Figure 4.

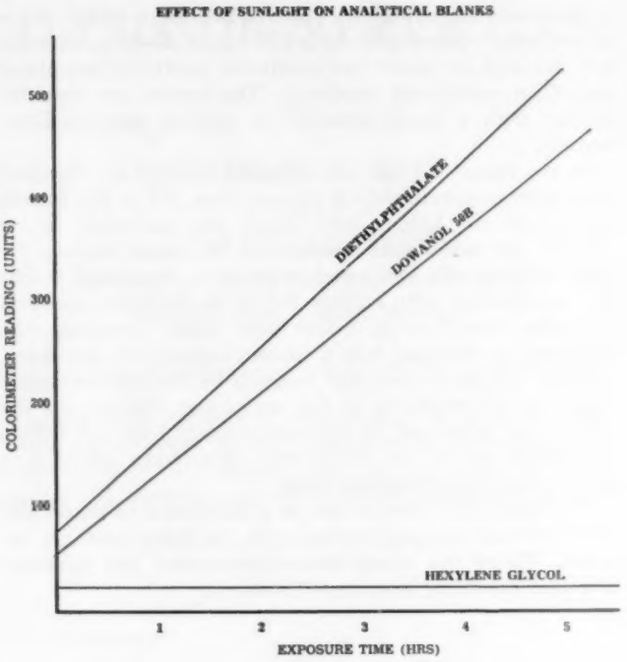


Figure 4

It is worth mentioning that hexylene glycol showed no effects even after an equivalent of ten days of continuous sunlight exposure.

As mentioned, the sensitivity of the overall analytical scheme varies with each absorbent. This is due mainly to the volume of the final colored reaction solution. These absorbents which are insoluble in water require more reagents to obtain the final homogenous colored solution. A comparison of the sensitivities is given in Table IV.

TABLE IV

ANALYTICAL SENSITIVITY

GB (SARIN)

SCHOENEMANN REACTION

ABSORBENT	1 VOL SAMPLING (ML)	2 ABSORBENT USED IN ANALYSIS (ML)	3 VOL OF REAGENTS (ML)	4 TOTAL VOL (ML)	5 DETECTABLE* CONC.
HEXYLENE GLYCOL	10	10	7	17	3.7
DEP	10	10	13	23	4.9
DOWANOL 50B	10	10	17	17	7.5
SILICONE 2	20	2	13	15	20.0
TETRALIN	20	2	6	8	21.0

↑ INCREASED SENSITIVITY

* ASSUMING A SAMPLING RATE OF 1 L/MIN FOR 1 MIN.
CONCENTRATION THAT CAN BE ESTIMATED WHEN A NET COLORIMETER READING OF 10 SCALE UNITS HAS BEEN OBTAINED.

The use of a reacting absorbent such as aqueous hydroxide has its merits. Ten ml. of a 2% solution has been found to be quite satisfactory for absorbing 95% Sarin and Tabun vapors with a flow rate of 1 1/min. In the case of Sarin, phosphate and fluoride analyses can be performed. In the case of Tabun, phosphate and cyanide analyses can be determined.

The various types of equipment used in sampling the nerve gases in the field are shown in Figures 5, 6, 7, and 8.

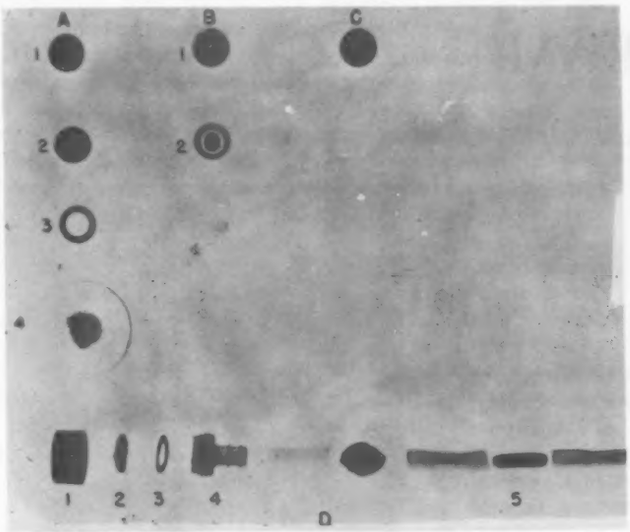


Figure 3
Details and Assembly of Silica Gel Sampling Device.

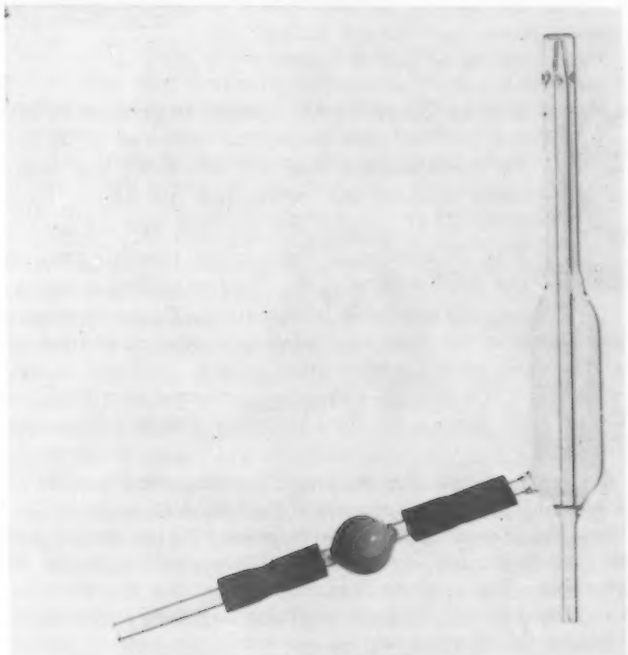


Figure 6
VAPOR AND AEROSOL SAMPLER MICRO IMPINGER BUBBLER
This device is used primarily to obtain low concentrations. The unit is charged with 4 ml. of absorbent. The analytical technique is similar to that described in figure 5.

These absorbents and techniques are by no means final. There are many areas for further development. For example, in the study of decomposition of G-gases due to explosive action, two types of absorbents are used, hexylene glycol for the active agent, and 2% caustic for total phosphate determination. A common absorbent would be highly desirable. Another area for improvement lies in the sensitivity. With our present field methods, dosages of two can be estimated with an accuracy of 20%. An improvement in the sensitivity by a factor of ten would be highly desirable.

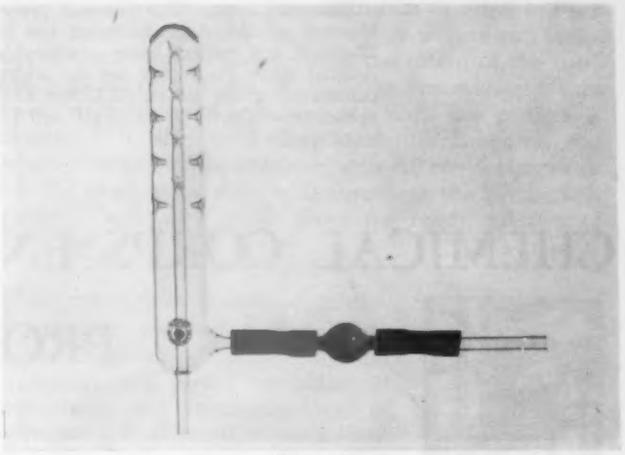


Figure 5
VAPOR SAMPLER EDGEWOOD BUBBLER
This bubbler is used primarily for vapor sampling. The bubbler is charged with 10 ml. of absorbent, and after collection of the air sample, the analytical reagents are added directly into this device to obtain the characteristic reaction color.

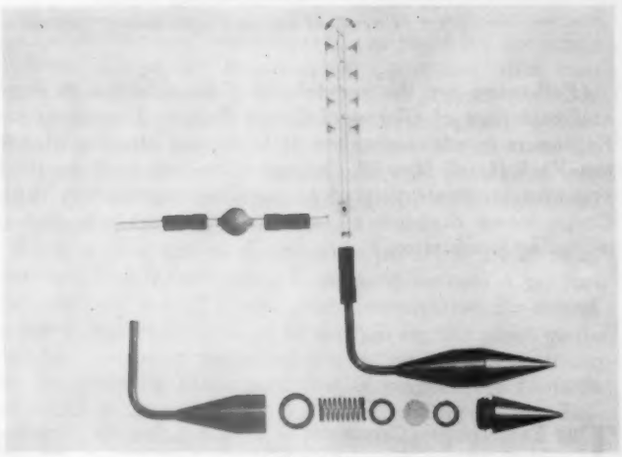


Figure 7
VAPOR AND AEROSOL SAMPLER
ISOKINETIC SAMPLERS WITH BUBBLER
These devices are used when aerosol and vapor are present in the nerve gas cloud. The filter mat collects the aerosol while the bubbler, charged with absorbent, collects the vapor. The latter also collects whatever aerosol that may evaporate from the filter mat.

Figure 8
GROUND CONTAMINATION DENSITY
SAMPLING PAN AND BOTTLE
This device is used to obtain ground contamination density. A given volume of an absorbent is poured into the pan. After dissemination of the nerve gas has been completed, the solution is mixed well and poured into the bottle via the rotating spout.

(EDITOR'S NOTE: The Journal presents here further report on the 12th Annual Meeting of the Association at the Sheraton-Park Hotel, Washington, D.C., May 22-23, it not having been practicable to cover all of the speeches in the July-August issue. Following are the address (in part) of Colonel William J. Allen, Jr., commanding the Chemical Corps Engineering Command, and also resumés of the speeches of Dr. E. A. Metcalf and Dr. Arnold G. Wedum of the Chemical Corps laboratories.)

CHEMICAL CORPS ENGINEERING COMMAND PROGRAM

By COLONEL WILLIAM J. ALLEN, JR.
Commanding Officer
Chemical Corps Engineering Command

(Following are the remarks of Colonel Allen in respect to the functions and activities of Chemical Corps Project Engineers and Associate Project Engineers in addressing the 12th Annual Meeting of A.F.C.A., at the Sheraton-Park Hotel, May 22. Colonel Allen tells how the Project Engineer system provides for continuity of cooperative engineering supervision of Chemical Corps items through all stages, from research and development to and including production.)

THE ENGINEERING COMMAND is assigned the responsibility in connection with the end items to accomplish the necessary engineering work to insure mass-producibility of the items developed by the Research and Development Laboratories and to provide the necessary engineering documents; i.e., drawings, specifications, technical manuals, etc., and to assist the Materiel Command in solution of production difficulties when the items go to production. Upon completion of development of an agent or other bulk-type chemical, Engineering Command is responsible for plant engineering and for preparation of a Unit Plant Design to produce the material.

As you know, the Army Chemical Corps is organized into four (4) major commands: Research and Development, Engineering, Materiel and Training Commands. I propose to limit my remarks to the relationship between Research and Development, Materiel and Engineering Commands.

Some people have a concept that the engineer, and the Engineering Command, are always in the middle. We do not accept this concept. We think of engineering responsibilities as commencing with the start of development and never ceasing until the item or process has been declared obsolete. In this way, our responsibilities play up and down an entire keyboard of activities. There was a time, perhaps, when the engineer could sit back and wait for the development people to complete an item or process and then come in and modify the design as required for production and then turn it over to the production people to produce it. We can't afford this sequential scheme of things. We must ensure that the talents of our engineers and of the production personnel from Materiel Command are brought to bear on the item or process at the earliest possible time in the development cycle. We had to find a way to pool all available talents in the Corps to ensure the best possible item in a minimum amount of time at a minimum cost. Consideration of this area led to development of a concept commonly referred to within the Corps now known as the Associate Project Engineer Concept.

AS SOON AS THE Research and Development project is established by appropriate Technical Committee action, the Research and Development Laboratories assign an individual as a responsible project engineer to prosecute the project. Simultaneously, the Engineering Command selects its most qualified engineer and assigns him to the project as an associate project engineer. Similarly, the Materiel Command assigns an associate project engineer. The first responsibility of the Engineering Command Associate Project Engineer is advance planning in determination of the knowledge requirements of the Engineering Command and Materiel Command. By this, we mean the associate project engineer contacts each division in the Engineering Command to ascertain what data they will have to have pertaining to the item to accomplish their engineering mission. The same thing is done at Materiel Command. For instance, the associate project engineer will go to the

person responsible for preparing specifications and say, "What will you need to know about this item in order to write a specification at the proper time with a minimum of delay?" He will go to the storage people and say, "What will you need to know to store and ship this item?" The storage man will probably say, "I will want to know how it is to be packaged, its weight and other dimensions. I want to know how you can tell when the item is leaking, if it is a filled munition. I want to know what to do with it when it does leak, etc." Each of these questions, we consider a knowledge requirement. The associate project engineer accumulates the total knowledge requirements of Engineering Command and Materiel Command, and then sits down with the Research and Development project engineer and says, "This is the information or data, that we are going to need about this item in order to carry out our mission. How much of this can you, by careful programming of your development work and development testing, provide for us?" When this has been determined, the associate project engineer then, by difference, knows what information or data he has to obtain elsewhere. With this type of pre-planning, little is left to guess and the project engineer is in a much better position to program his development work so as to be sure that the data that we and Materiel Command require will be available when required.

HAVING DONE THIS, the associate project engineer, working with the project engineer, follows carefully the development of the item or process. In so doing, he has full authority, in Engineering Command, to draw upon all the talents available within the Command and make them available to the project engineer in any way that will assist in ensuring that upon completion of development, no engineering changes will be necessary to ensure mass-producibility of the item or material. In other words, we try to get all of our engineering work done on an item or process while it is going through the development cycle without unduly interfering with development. There is always a possibility that some modification will be required after the item is completed. However, this can be held to a minimum by this system where we strive to get all our engineering done during development.

Now when development is completed, the item is transferred to us for finalization of drawings and specifications. Our associate project engineer then becomes the project engineer and the Research and Development project engineer becomes an associate, with the Materiel Command associate project engineer becoming much more active at this stage. We feel that the Research and Development associate project engineer must retain a strong interest to ensure that any engineering modifications that we feel must be made do not, in his opinion, change the functionability of the item. Likewise, the Materiel Command associate project engineer has a very real interest in how the design is finalized and the specifications and other procurement documents are prepared.

When we complete our procurement documents and turn them over to Materiel Command for production, our project engineer reverts to an associate project role, the Research and Development man continues as an associate, while the Materiel Command associate becomes the project engineer during the production cycle. These two associates are then with him to bring to bear on any production problems, the entire talents and facilities of their two commands. It is the intent of the concept, and also the intent of the three commanders, that the three men serve continuously until the project is completed. In this way, they have the Research and Development man, the engineer who did the design work and the production man who considers the production problems, available at all times for ready solution of difficulties.

THIS CONCEPT IS ALSO used in discharging another responsibility of the Engineering Command, that is, design and initial operation of new plants and accomplishment of major modifications to existing plant facilities. During construction of a new plant by the Corps of Engineers, our project engineer would be assigned to work with the Corps of Engineers and the Architect Engineer, providing all technical assistance to them during the course of construction. Upon completion of construction and acceptance of the plant for the Army Chemical Corps by Engineering Command, this man would be considered in the role of a project engineer during the run-in and round-out of the plant by Engineering Command prior to turning the plant over to Materiel Command for operation. The personnel required to operate the plant during this stage would be furnished by Materiel Command.

When a program of modification of a plant has been approved, the Engineering Command assigns a project engineer to the staff of the plant commander. He serves as the technical supervisor of the job for the plant commander, receiving technical advice and guidance from the Engineering Command. He is responsible to both the plant commander and the Commanding Officer, Engineering Command, that the job is accomplished well and on time and within the over-all responsibility of the plant commander. This type of organization permits the entire talents and facilities of the Engineering Command to be made available to that plant commander through our project engineer. Our project engineer has authority to call on any shop in the Engineering Command for such assistance and support as may be needed for the job. This type of assistance is similarly provided from Research and Development Command and Materiel Command through their associate project engineers. In this manner, we marshal the entire know-how and ability of the Army Chemical Corps and focus it on the job through the project engineer.

This system has been in use for approximately two years and has been most instrumental in helping us to accomplish our mission of providing the best possible engineering in the shortest time at the lowest cost.

* * *

NOW I WOULD LIKE to talk for a few minutes about a management tool that has been developed by the engineers in Engineering Command. This is one of handling the great mass of data generated by the Chemical Corps Surveillance Program and making it available in a pre-digested, understandable form for the project engineer to take action promptly to overcome defects in material brought to light by the program of surveillance.

One of the most effective tools that our project engineers have is our data control system which has been established to evaluate both field and environmental

surveillance data. In order to best describe how this data control system works, let me spend just a moment in characterizing the two surveillance programs in which the data is generated.

The field surveillance program consists of a series of annual inspections that are conducted on all of our depot-stored material. To assist in these inspections, we have prepared a series of surveillance specifications—one for each item of issue for which we have responsibility. These specifications are used by the depot commanders as the inspection standard and they require that each inspection be covered by a comprehensive report, which is submitted to our organization. These reports are generated at the rate of approximately 80,000 a year and reflect all possible storage conditions and item histories, both domestically and abroad.

The other surveillance program, Environmental Surveillance, consists of a series of periodic inspections conducted under semi-controlled conditions on all major end items. These inspections are conducted at the four (4) environmental test sites —the Arctic in Alaska, Desert in Yuma, Arizona, the Tropic in Panama, and the Temperate and Control located at Army Chemical Center. The data generated from this program is similar to that generated in the Field Surveillance Program; however, it is more extensive in that the objective in determining design adequacy is emphasized.

(Colonel Allen concluded his presentation with a showing of photographic slides illustrating how information concerning the condition of material in storage is recorded and analyzed. The system involves the use of IBM cards and processing machines. Colonel Allen pointed out that through the use of a coding system a great mass of surveillance information becomes readily available and that the system facilitates various important statistical studies, including especially the determination of the rates of deterioration of material in storage. Colonel Allen stated that the Chemical Corps had made very marked progress in collecting, recording and analyzing surveillance information.)

MANY AEC REPORTS AVAILABLE

The Atomic Eneregy Commission has announced the titles of 1063 previously-classified technical reports that are now available as open literature. This is the first group of a series of titles that will be released under the Commission's current major declassification program.

The first titles declassified are contained in *Report Announcement Bulletins* Nos. TID-1911 and TID-1912, issued by the Technical Information Service Extension, Oak Ridge, Tennessee. *Report Announcement Bulletins* may be obtained free and the reports listed may be purchased from the Office of Technical Services, Department of Commerce, Washington 25, D.C.

The newly-declassified documents concern such areas as biology and medicine, chemistry, separation processes, controlled thermonuclear processes, criticality studies, health and safety, instruments, isotope separation, metallurgy, ceramics, particle accelerators and high-voltage machines, physics and mathematics, radiation effects, radioactive waste, reactors, and technology.

BIOLOGICAL WARFARE SCIENTISTS PIONEER IN LABORATORY SAFETY

Resumé of address by Dr. Arnold G. Wedum, Biological Warfare Laboratories

DR. ARNOLD G. WEDUM, Safety Director of the U.S. Army Chemical Corps Biological Warfare Laboratories, Fort Detrick, Md., in addressing the Armed Forces Chemical Association at the 12th Annual Meeting in Washington D.C., on May 22, stated that biological warfare scientists have at least two problems in common with future space travelers. These two problems, he said, are psychological adjustment to living under confining conditions, and disposal of wastes, trash, air and sewage. He said that these difficulties were part and parcel of the Fort Detrick, laboratories' carefully devised safety program, now achieving impressive safety records. The lab buildings have special sterilizing equipment to assure that none of the wastes can cause infection. To confine risks, researchers often work in air-tight clothing or ventilated hoods.

The post's safety program was stepped up after World War II, when the accident and sickness count showed that conventional safety practices and devices needed further study. The resulting methods and equipment developed by Fort Detrick men were made available to other institutions concerned with medical research and public health, and many are now in use in laboratories all over the nation.

In 1945, for example, safety men began to use high-speed photography to study common laboratory practices. The pictures showed that disease-causing organisms were being liberated into the air during operations customarily regarded as safe—even in such acts as pulling a rubber stopper from a bottle of bacterial culture. The eye of scientific study was then shifted to other operations and the idea gradually evolved that "externalizing" often gave the best protection to workers.

This meant physically separating the worker from the dangers of his work with bacteriological hoods or "cabinets," some of which have arm-length gloves. With these, the lab technician stands in front of the cabinet, manipulating the material inside it by thrusting his hands and arms through the glove sleeves.

Fort Detrick safety methods are guided by the two specifications that it must be possible for a scientist to do any experiment he may have to do with any infectious or poisonous materials—no matter how dangerous, and that no scientist must become ill to get his job done. When the system of separating the man from his work becomes too cumbersome, another form of protection is

used—the worker dons a gas mask, a ventilated hood, or a ventilated suit.

For use under these conditions, there is a varied array of ingenious laboratory instruments. There are mechanical pipettors, for example. For several decades, biologists used a simple hollow tube and a form of vacuum to transfer dangerous liquids from one container to another. (Soda-fountain dawdlers unwittingly use a form of pipetting when they dip the straw into a glass, filling the straw's bottom end and then closing its upstanding end with a finger. The liquid does not drain from the straw, even when lifted from the glass, so long as the finger keeps an air-tight seal. It can even be carried to and poured into another container.) Bacteriologists sometimes carried the tube idea a little further, often on the side of danger, by sucking the liquid higher before sealing the end.

The high-speed camera showed that both these practices were dangerous—hence the mechanical pipettors.

Another such device is the magnetic mixer, which operates by whirling a bit of metal in the bottom of a bacterial test tube. The metal is given movement by a whirling magnetic field located outside the tube. Lab workers at one time mixed these solutions by manual shaking or by blowing air into the tube, liberating in the process an invisible but nevertheless harmful mist of infectious material into the air.

Some of these devices were developed at Fort Detrick and others were taken from the commercial market. Many of the latter were considerably improved and modified by Chemical Corps scientists and engineers.

—From Army News Service

INDUSTRY AIDS IN SEARCH FOR CHEMICAL WARFARE AGENTS

Resumé of address by Dr. E. A. Metcalf, Chemical Warfare Laboratories

THE AID OF INDUSTRY is being enlisted by the U.S. Army Chemical Corps in its efforts to find new chemical compounds, processes, and information which can be used in its research work on chemical warfare agents.

The Industrial Liason Program, under which such aid is invited was described on May 22 to members of the Armed Forces Chemical Associaton during its 12th Annual Meeting, at the Sheraton-Park Hotel, Washington, D.C., by Dr. E. A. Metcalf, U.S. Army Chemical Corps scientist. Dr. Metcalf heads the Industrial Liaison Office of the U.S. Army Chemical Corps Warfare Laboratories, Army Chemical Center, Md.

In his talk, Dr. Metcalf stated that the search for new chemical warfare agents and the mechanisms by which they act is only a fraction of the total research interest of the Chemical Corps. For this, the Industrial Liaison Program has been broadened to include a search for information of value to all research programs of the Chemical Warfare Laboratories.

The general areas of interest in the program include such things as compounds of a highly lethal nature and those having marked convulsant, sedative or incapacitating action. In the same general category are compounds which will produce physiological effects so unpleasant that personnel will be unable to carry out their assigned duties and will have to seek immediate protection.

Another group, about which the Chemical Corps is seeking information from industry, includes compounds which have therapeutic or prophylactic value counteracting the effect of chemical warfare agents.

The Corps is also interested in substances, compounds, or mixtures which have specialized properties such as: gelling, thickening, incendiary, decontaminating, and smoke producing.

A fourth group includes information concerning detection of chemical warfare agents and nuclear radiation and the protection and decontamination of personnel or material exposed to their effects.

Dr. Metcalf stated that it is expected that the scope of the program will be broadened to include biological warfare, development work, and other fields of interest.

Now in the files of the Industrial Liaison Office are information concerning over 2,000 chemical formulae, suggestions and ideas representing millions of dollars worth of research that the chemical industry has submitted to the Army Chemical Corps. At present over 300 of the nation's 3,000 industrial laboratories have been contacted and are cooperating in varying degrees with the program. Some companies are submitting monthly lists of newly prepared compounds along with as much biological data as they have available. Others are opening their chemical and biological files to Chemical Corps representatives.

Extraordinary precautions are taken to insure that information submitted by industry does not get into unauthorized hands, Dr. Metcalf explained. Only very few people in the Chemical Corps are given access to the carefully guarded information.

In closing, Dr. Metcalf stated that the program has proven mutually beneficial both to cooperating companies and the Chemical Corps, and it is hoped that the program can be broadened to include the majority of the nation's industrial laboratories.

—From Army News Service

ILLINOIS DEGREE TO DR. ADAMS

Professor Roger Adams, past president of the American Society for the Advancement of Science, received an honorary degree of Doctor of Science at the June 15 Commencement ceremonies of the University of Illinois where he had been a member of the staff since 1916.

Doctor Adams headed the Chemistry Department at Illinois from 1926 to 1954 when he was relieved of administrative duties, at his own request, to devote full time to research. Under his leadership the Chemistry Department at Illinois earned worldwide recognition and many of today's leaders in chemistry studied under him.

Doctor Adams, who has A.B., A.M. and Ph.D. degrees from Harvard, has previously received Doctor of Science degrees from Brooklyn Polytechnic Institute, Northwestern University, University of Rochester, Harvard University, University of Pennsylvania and Yale University.

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CHEMICAL CORPS NEWS

GEN. ROTHSCHILD TO RETIRE; GEN. STUBBS MOVES TO BRAGG; COL. WALMSLEY HEADS MATERIEL

A number of changes in top positions in the Army Chemical Corps establishment have recently been made or are in the making.

Brig. General Jacquard H. Rothschild, commanding the Research and Development Command, has requested retirement from active duty to be effective early this Fall. It is understood that Gen. Rothschild, after an extensive period of travel abroad, plans to enter the teaching field, at the University level. General Rothschild, born in Ohio on December 22, 1907, is a graduate of the U.S. Military Academy (1930), and has a MS degree in Chemical Engineering from Massachusetts Institute of Technology (1940). During World War II he headed the Chemical Corps Research Laboratories at MIT and later commanded a chemical mortar battalion in the European Theater. He served as Chief Chemical Officer in the Far East during the Korean operations before his promotion to Brigadier-General and current assignment. No announcement has been made in regard to a successor to General Rothschild.

Another important change recently effected was in the command of Army Chemical Center, Maryland, and of Chemical Corps Materiel Command. Brigadier General Marshall Stubbs, who held both these positions, has a new assignment to Headquarters, First Logistical Command, Fort Bragg, N.C. His replacement for both positions is Colonel Harold Walmsley, whose last assignment was Commanding Officer, U.S. Army Chemical Procurement District, New York.

General Stubbs, a native of Nebraska, was graduated from West Point in 1929. He also has a MS degree in Chemical Engineering from MIT. During World War II, he served in the European Theater of Operations. After the war he attended the National War College, then headed the Research and Development Division of the Chemical Corps before assignment to the Materiel Command in 1954.

Colonel Walmsley is a graduate of the U.S. Military Academy, class of 1932. He was Chemical Officer of the Ninth Army in the European Theater of Operations in 1944-1945. He is a graduate of the Industrial College of the Armed Forces.

Colonel John J. Hayes, who commanded the Army Chemical Corps Biological Warfare Laboratories at Fort Detrick, Md., for nearly four years, has been reassigned to attend the Army War College, at Carlisle, Pa. His replacement is Colonel Donald G. Grothaus, whose last assignment was Commanding Officer of the Rocky Mountain Arsenal, at Denver, Colo. The new Commander of Rocky Mountain Arsenal is Colonel Ronald L. Martin.

Colonel C. J. Merrill, who has been Deputy Commander of the Chemical Corps Materiel Command, recently received a new assignment to attend the Armed Forces Industrial College at Fort McNair. Colonel Merrill, on that occasion, was awarded the Army Commendation Ribbon with Metal Pendant, for outstanding work in initiating "improved policies for operations" during his three years with the Materiel Command.

This picture may well serve to illustrate the recent change of command at Army Chemical Center; it shows Chief Chemical Officer, General Creasy, greeting Colonel Walmsley (right) while General Stubbs (left) looks on. Actually, this picture was taken over a year ago on the occasion of a career management seminar of the Corps held in Baltimore where Colonel Walmsley was a visitor from New York. —U.S. Army Photo

COL. EUGENE G. BENNETT IS THE NEW DEPUTY COMMANDER AT ACC

Edgewood, Md. — Colonel Eugene G. Bennett has been named deputy commander of the Army Chemical Center, succeeding Colonel Walter L. Maclachlan, who recently retired.

An alumnus of the University of Cincinnati with a degree in chemical engineering, Colonel Bennett worked with the Champion Paper and Fiber Company in Hamilton, Ohio before he was called to active duty in 1941. Commissioned originally in the Coast Artillery, Colonel Bennett served in Europe and the Philippine Islands in World War II. He was integrated into the Regular Army in 1947 and transferred to the Chemical Corps. Since the war Colonel Bennett has served with the Chemical Warfare Laboratories at Army Chemical Center, as Chemical Officer for the United States Army in Europe (1953-56) and as Commanding Officer of Edgewood Arsenal.

OTHER KEY CHANGES

Colonel Charles H. McNary who, until recently, headed the U.S. Army Chemical Procurement District, Chicago, has been reassigned as Commanding Officer of the 81st Chemical Group at Fort Bragg, N.C. He is replaced in Chicago by Lt. Colonel Nelson F. Skinner.

Colonel Maurice A. Peerenboom has been assigned as Chemical Officer, U.S. Army, Pacific. He formerly commanded the 100th Chemical Group at Ft. McClellan, Ala.

Colonel Walter W. Kuehler has been assigned as Chemical Officer of the Fifth Army, Chicago.

RETIREMENTS

COL. MACLACHLAN AND MAJ. STEPHENS

EDGEWOOD, MD.—Two officers at the Chemical Center, who ended their Army careers June 30 and retired, were Colonel Walter L. Maclachlan, former deputy post commander, and Major Louis P. Stephens, assistant inspector general, Office of the Chief Chemical Officer.

Colonel Maclachlan was commissioned in the Army Reserve in 1923. Called to active duty in 1942, he served with the Boston Chemical Procurement District until his departure for overseas in 1946. In 1947 he was integrated into the Regular Army. He returned to the United States in 1949, was assigned to the Chemical Center in 1951 and was appointed deputy post commander there in 1954.

Colonel Maclachlan has received the Army Commendation Ribbon, the Army of Occupation Medal (Japan), and the Armed Forces Reserve Medal. He was born at Melrose, Massachusetts; has a Bachelor of Science degree in Economics from Harvard University.

Major Stephens began his Army career as an enlisted man at the Chemical Center in 1928. He was commissioned in 1942 and, during World War II, served as an instructor at the Chemical Corps School, and as commanding officer of the 5th Chemical Company. Recalled to active duty in 1950 as a captain, he was made adjutant of the Chemical Replacement Training Center, and later went to Korea and participated in the Second Korean Winter, Korean-Summer-Fall of 1952, and the Third Korean Winter campaigns.

Among his decorations are the Bronze Star Medal, Army Commendation Ribbon, Korean Service Medal, Armed Forces Reserve Medal, and the Distinguished Unit Citation Badge.

COL. HAROLD W. GOURGUES

EDGEWOOD, MD.—Lt. Colonel Harold W. Gourgues, whose last assignment was Director for Supporting Activities at the Army Chemical Center, retired in the grade of Colonel in April this year.

Starting his military career as an enlisted man in the National Guard in September of 1927, he was commissioned in the Army Reserve in May 1931. Col. Gourgues is an alumnus of Louisiana State University and a former superintendent of education in his native Thibodaux, Louisiana. In World War II he took part in the invasion of North Africa and Italy as a liaison officer with the French Army. In 1945, he was transferred to the China Theater Headquarters where, for almost two years, he served as Theater Quartermaster. He returned to Europe in 1949, and held positions at European Command (ECOM) Headquarters and the Seventh Army.

Colonel Gourgues has the Bronze Star Medal; Special Breast Order of Yun Hwi with Ribbon of Republic of China; European, Africa and Middle East Campaign Medal with one star; and the Asiatic-Pacific Campaign Medal.

MR. EUGENE W. JAY

EDGEWOOD, MD.—Mr. Eugene W. Jay, chief of the Experimental Fabrication Branch, Engineering Division, Chemical Warfare Laboratories, completed 38 years' Federal service, 36 at the Center, and retired June 30.

Coming to the Center in 1921, Mr. Jay assisted in the development of the 4.2″ chemical mortar. He was responsible for the fabrication of all experimental and developmental chemical warfare items.

Mr. Jay was honored at a testimonial dinner at the Officers Mess and was given letters of appreciation, a certificate of achievement and check for $300 for his sustained superior performance of duties.

AIR FORCE RESERVISTS

ARMY CHEMICAL CENTER, MD.—Ninety Baltimore Air Force reservists spent one day visiting several facilities of the Army Chemical Center and received training in the latest tactics and doctrine of chemical, biological and radiological warfare.

Members of the 8450th Air Reserve Group of Baltimore, under the command of Colonel William J. Bullen, 408 Overbrook Rd., were given three hours of formal orientation in the morning and rounded out the tour in the afternoon by visiting the Chemical Corps' museum.

MOBILE LABORATORY FOR CHEMICAL CORPS

A mobile laboratory has been developed by the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, for use by the Army Chemical Corps.

A rigid frame van body, mounted on a semi-trailer, it provides facilities for performing biological, chemical, physical and sanitary engineering studies in the field.

Completely insulated, the van is equipped with a heater and an air conditioner; all-metal cabinet and shelves and acid-resistant tables, an air compressor, vacuum pump, botttled gas storage tank, a 600 gallon-per-hour water pump, a 40-gallon hot water tank, a distillation unit, a fume hood with an exhaust blower, two biochemical oxygen demand incubators, a 37-degree (C) incubator, a dry sterilizer and an autoclave. The unit is illuminated by fluorescent lighting, can also be mounted on a standard Army 2½-ton truck chassis.

The new laboratory gives the Chemical Corps a compact and efficient unit which materially reduces preparation time for field testing trips.

RECENT AWARDS AND DECORATIONS

Exceptional Service Award To Mr. O'Hehir of Rocky Mt. Arsenal

Mr. John P. O'Hehir (center in picture above) Comptroller of the Chemical Corps' Rocky Mountain Arsenal at Denver, Colo., is shown being congratulated by Secretary of the Army, Wilber M. Brucker, who has just decorated him with the Exceptional Civilian Service Award Medal. General Creasy, Army Chief Chemical Officer, is at the right. The ceremony was held in the Pentagon, Washington, D. C., on July 10, 1957. Mr. O'Hehir was cited for his outstanding work as leader of a team responsible for establishing the Army Industrial Funding Program at Rocky Mountain Arsenal.

Office of the Chief

Mr. James W. Cone, program analyst, office of the Comptroller, suggestion award, $300 cash.

Mrs. Elsie W. Fisher, secretary, office of the Assistant Chief Chemical Officer for Planning and Doctrine, Sustained Superior Performance Award—Certificate and $200.

Mr. Armand D. Fournier, Chemical Corps Intelligence Agency, for Sustained Superior Performance—Certificate and $200.

Mrs. Frances L. B. Hart, occupational analyst, Career Management Division, Outstanding Performance Award-Certificate and $200.

Mr. Rudolph E. Hegdahl, Chief of the Welfare and Morale Branch, Administration Division, for Sustained Superior Performance—Certificate and $300.

Mrs. Lillian C. Holland, Chemical Corps Intelligence Agency, for Outstanding Performance Rating—Certificate and $200. Mrs. Holland had previously received a cash award and certificate for Sustained Superior Performance.

Mrs. Helen H. Little, procurement clerk, Logistics Planning Division, Sustained Superior Performance Award—Certificate and $200.

Miss Glady L. Miller, Administrative Assistant in Logistics Planning Division, for Sustained Superior Performance—Certificate and cash award.

Mrs. Vauda M. Owendoff, Office of the Assistant Chief Chemical Officer for Planning and Doctrine, for Sustained Superior Performance—Certificate and $200.

Mr. Neal N. Reid, Civilian Personnel Branch, Career Management Division, for suggestion which materially expedites the recruitment of highly qualified employees —Certificate and a $25 Suggestion Award.

Mr. Charles W. Robinson, Mail and File Supervisor, Administration Division, Sustained Performance Award —Certificate and $200.

Mrs. Florence E. Trivers, clerk-typist in the Career Plans and Policies Branch, Career Management Division, for Sustained Superior Performance—Certificate and $100.

Mr. William H. Van Sant, production specialist, Logistics Planning Division, for Sustained Superior Performance—Certificate and $300.

Chemical Procurement Dist.—San Francisco

Mr. Clifton D. Bethel, Chemical Planning Division, for Sustained Superior Performance—Certificate and $300. Mr. Bethel also received the Department of the Army Commendation of Meritorious Service award, presented on behalf of the Chemical Corps Chief Chemical Officer, by Lt. Col. Vincent Kosebutski, Commanding Officer of the District.

Miss N. Theresa Valdavinos, Mail & Record Admn. Section, for Outstanding Performance of assigned duty —Certificate and $100.

Chemical Parts Center—Memphis General Depot, U.S. Army

Mrs. Katherine W. Richert, supervisor in the Supply Branch, Chemical Stock Control Division, Outstanding Employee Performance Appraisal award. Mrs. Richert also received a $200 cash award for her accomplishments.

Mrs. Mabel J. Parham, for outstanding accomplishments in the Property Disposal Function—Certificate and $200.

Mr. Rex Little, Document Processing Branch, for Sustained Superior Performance—Certificate and $100.

Army Chemical Center

Brigadier General Marshall Stubbs, Army Chemical Center Commander, recently presented Sustained Superior Performance Award Certificates and checks for $300 to each of the following Chemical Center employees:

Mr. William S. Harmon	**Mr. John M. Roche**
Mr. Gordon N. Jarman	**Mr. Samuel Sass**
Mr. Abbott B. Rhodes	**Mr. Theron M. Vining**
Mr. Merle Ringenberg	**Mr. Vincent K. Younger**

In Mr. Younger's case an additional award with check for $225 was presented in connection with the award for a money-saving suggestion respecting the purchase of sodium nitrate which was made by Mr. Younger sometime ago.

At another recent presentation ceremony, General Stubbs presented special awards as follows:

Lt. Colonel Anthony Morse, post finance officer, Certificate of Achievement for work performed on a previous assignment as chief of Accounting Section, Headquarters Second Army;

Mrs. Edward J. Dehne, wife of Lt. Colonel Dehne, certificate awarded by the Library of Congress for her work in transcription of material into Braille for the education of blind children;

Specialist third class **Charles R. Scott,** Certificate of Achievement for service on a previous assignment to the First Cavalry Division;

Mr. Donald Hair, assistant post Special Services officer, Certificate of Accomplishment awarded by the Secretary of the Army to the Special Services Section, for its library publicity program in which the Army Chemical Center library won first place in the judging by the Second Army.

SAFETY AWARD TO CHEM. LAB.

ARMY CHEMICAL CENTER, MD—J. E. Voeglein, Jr., chief of the Chemical Warfare Laboratories safety office, recently received the Certificate of Merit for Safety presented to the laboratories by Major General William M. Creasy, Chief Chemical Officer. Mr. Voeglein and his staff were commended for promoting safety consciousness among personnel and for the laboratories' safety record in 1956.

COLONEL DONALD H. HALE RECEIVES LEGION OF MERIT

Col. Donald H. Hale, former commanding officer of the Chemical Corps Research and Engineering Command, who retired last August, received the Legion of Merit decoration at the Army Chemical Center, on June 19. Presentation was made in connection with the parade ceremonies at the Post in celebration of the 182nd birthday of the U.S. Army.

Colonel Hale stood with Brig. General Marshall Stubbs, Post Commander, in the reviewing stand. Currently engaged in research at the Applied Physics Laboratory, Johns Hopkins University, his award was for outstanding service while in charge of the Chemical Corps research program at the Center.

COMMENDATION RIBBON AWARDS

COL. FOLEY

MAJ. DEARTH

CAPT. MOORE

The Army Commendation Ribbon with Metal Pendant was recently awarded, by Major General William M. Creasy, Chief Chemical Officer, to the following officers of his staff: Colonel William Foley and Major James S. Dearth.

An Oak Leaf Cluster, denoting a second award of the Army Commendation Ribbon with Metal Pendant, was recently presented to Captain Donald P. Moore, at the Chemical Section, Fifth Army Headquarters in Chicago. Presentation was made by Colonel Eldon H. Larecy, Assistant Chief of Staff, G-4.

CHICAGO DISTRICT ENGINEER REWARDED FOR SUGGESTION

Mr. Samuel H. Melnick, production engineer in the Chicago Chemical Procurement District, recently received the Army Suggestion Award Certificate and cheque for $280 for suggesting an improved method of shipping aircraft bomb containers which it is estimated, will effect a yearly saving of $250,000. Picture above shows Mr. Melnick receiving the award from Lt. Col. Melvin H. Skinner, the Procurement District Commander.

DR. DZIEMIAN HONORED

Dr. Arthur J. Dziemian, deputy chief of the Chemical Warfare Laboratories' Biophysics Division, was given an Army Certificate of Achievement and a check for $300 at a presentation ceremony at the Army Chemical Center in Maryland on July 5.

Colonel Lloyd Fellenz, laboratory commander, pointed out that the contributions to scientific research made by Dr. Dziemian in his special field of "Wound Ballistics" research have helped greatly in stimulating others to further interests of the nation's scientific efforts.

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STRATEGIC RESERVE GROUP

EDGEWOOD, MD.—When members of the Washington, D.C. 400th and 476th Strategic Reserve Agencies visited this Chemical Corps post for a one day active duty reserve training tour, they were shown some of the reasons for wearing many items of special clothing in the handling of highly dangerous toxic chemical materials. Demonstrating precautions against possible burns while filling artillery shells with white phosphorous, Colonel Eugene Bennett, then commander of the Edgewood Arsenal, now deputy commander of the Army Chemical Center, is shown second from left in the picture pointing to an employe of the White Phosphorous Shell Filling Plant, wearing complete protective equipment necessary in the handling of phosphorous.

CHEMICAL CORPS FIRST LADIES

Mrs. Amos A. Fries, wife of General Fries, USA Retired, first Chief of the Chemical Warfare Service after its establishment following World War I as a permanent branch of the Army, is greeted by Mrs. William M. Creasy, wife of the present Chief of the Chemical Corps. The occasion was a recent luncheon of the Chemical Corps Officers Wives Club in Washington, D.C.

COL. McKAIG TO FLORIDA COLLEGE

Colonel Nelson McKaig, Jr., USA. (Ret.), has resigned as assistant professor in the College of Engineering, University of Wyoming, to accept a position in the Chemistry Department of the St. Petersburg Junior College, St. Petersburg, Florida.

WINS HARVARD FELLOWSHIP

Mr. Richard B. Williams, a biologist in the Chemical Warfare Laboratories at the Army Chemical Center, Md., was recently awarded a pre-doctorate fellowship at Harvard University. Mr. Williams plans to obtain his doctorate in oceanography. He has a degree in biology from the University of Buffalo and an M.A. in zoology from the University of Wisconsin.

HOSTESS VOLUNTEERS NEEDED

The Armed Forces Hostess Association, the "friend in need" to countless service families throughout the entire world, is in need of volunteers to serve as either Neighborhood or Pentagon Hostesses in the Washington Metropolitan area.

A volunteer organization of officers' wives, the group has as its main functions the jobs of extending a personal welcome to newly appointed officers and their families in the community and supplying assistance to all service personnel in their new environment.

At present there is a special need for typists, filing clerks and routine office workers. Officers' wives who wish to volunteer should call LIberty 5-6700, Ext. 76857.

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CHEMICAL CORPS LABORATORY UNIT IN JAPAN

U. S. Army Photo

PFC Kenneth Godfrey, Jr., runs a quality-control test on a sample of chemical re-agent made by a Japanese firm to see that it meets specification standards.

U. S. Army Photo

Sp-3 Michael Dunkle is shown focusing a projection microscope.

USEFUL SERVICES IN QUALITY CONTROL TESTING PERFORMED BY CHEMICAL CORPS DETACHMENT

ZAMA, JAPAN—(AFFE/8TH ARMY REAR)—The 43rd Chemical Detachment, the only chemical laboratory in the Far East, performs the dual functions of a mobile laboratory and a base or theater laboratory. This gives it almost as many functions as it has personnel, for it is a nine-man unit made up of two officers and seven enlisted men.

Its commander, Capt. Charles F. Lemr, has a degree in chemistry from Western Reserve University. Lt. Arthur H. Schultz, Operations Officer, is completing his degree through extension courses. The enlisted men are all laboratory technicians.

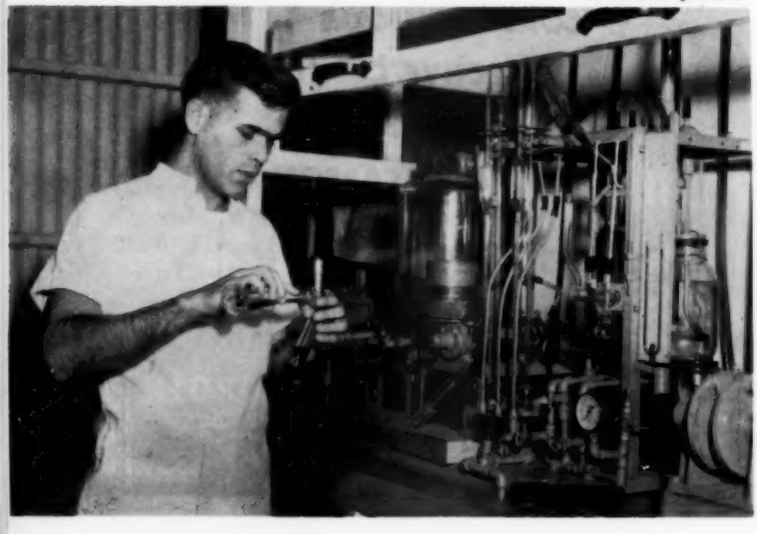
The laboratory's primary mission is technical assistance in evaluating enemy CBR material, including gas masks, chemicals, smokes and incendiaries. Since the end of the Korean Conflict, instead of merely reverting to a training status, the laboratory has taken on new functions. These activities resulted in savings of a quarter million dollars for the government in fiscal 1956, and a sixth million dollars in the first half of fiscal 1957.

These savings were realized through the local purchase of chemicals, whose purity is checked by this detachment. Quality control has become one of the lab's most important peacetime pursuits.

Not only the Army but the Japanese chemical industry has profited. The industry has learned the need for production control laboratories, and Capt. Lemr estimates that about 75% of the Japanese chemical industry is now exercising quality control.

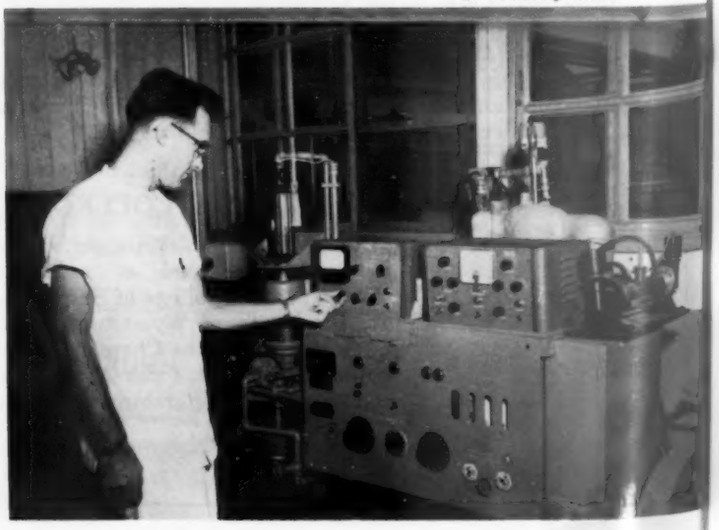
The E2 Canister tester determines the safety of gas mask canisters in connection with gases and other toxic agents. Sp3 Raymond Magers is busy preparing for another test.

U. S. Army Photo



Sp3 Dan Sellers is pictured operating a smoke penetration meter in the Lab. The meter indicates how much smoke can penetrate through the canisters of gas masks before the mask becomes unsafe.

U. S. Army Photo



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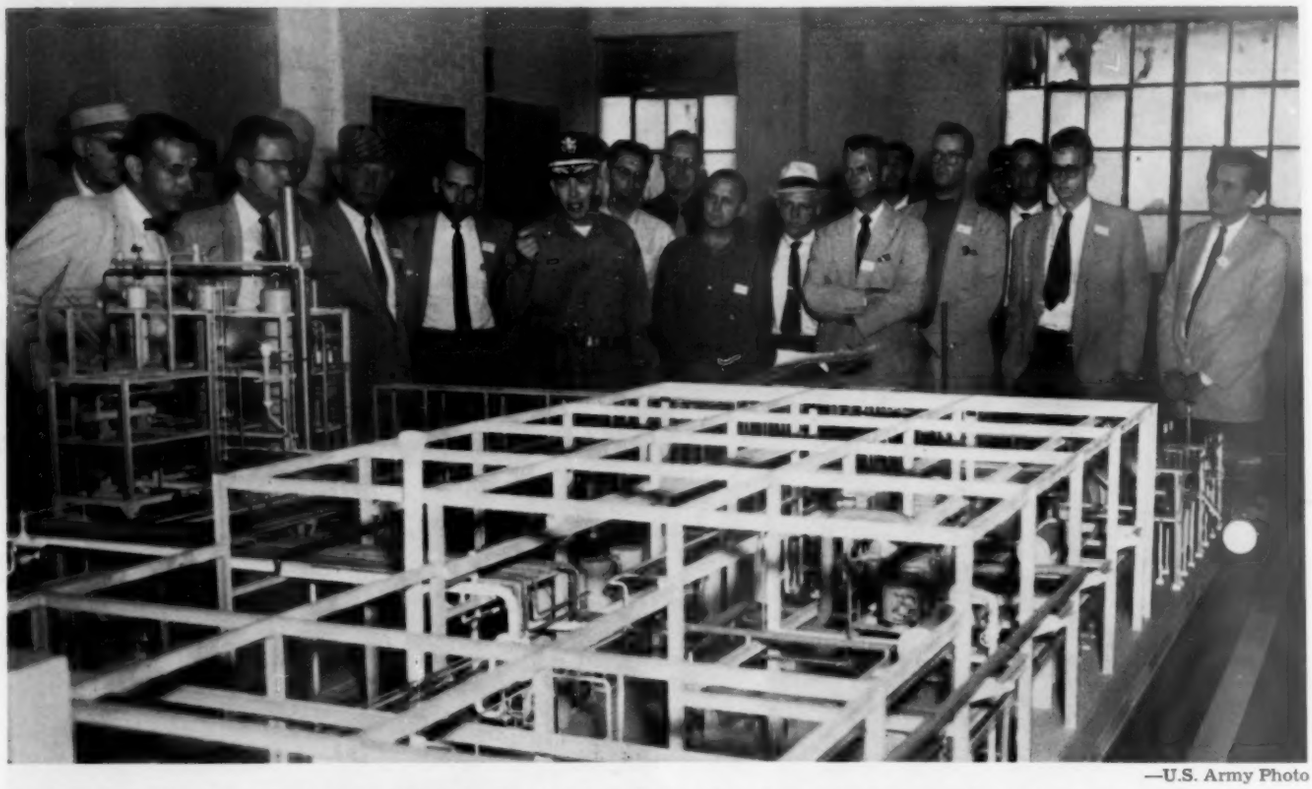

—U.S. Army Photo

Col. William J. Allen, Jr. (center), commander of the Chemical Corps Engineering Command, shows members of the U.S. Congressional and Command Group a scale chemical plant model and explains how the use of models serves as an important link between laboratory experimentation and production.

EDGEWOOD, MD.—Twenty-one Reserve Officers, members of the U.S. Army Congressional Command and Operations Group, spent a Saturday, June 29, touring the Army Chemical Center and attending orientations on the work being performed here in research and development, and in the manufacturing and handling of offensive and defensive Chemical Warfare materiel.

The Congressional Command Reserve Group was recently formed in Washington to consist of members of Congress and Congressional staff members who have reserve commissions, to permit these reservists to take a more active part in reserve training without interruption of their lawmaking functions.

Arriving in the early morning by helicopters, the group was shown the Chemical Warfare Laboratories, one of the Chemical Corps' major research and development facilities. Several hours were devoted to briefings and showings of the latest concept in experimentation of toxic war gasses, currently being conducted here. In addition to the laboratory visit there was a short tour of the post facilities followed by luncheon at the Officers' Club. Briefings during the visit were conducted by Brig. General J. H. Rothschild, Commander R&D Command; Brig. General Marshall Stubbs, Post-Commander; and Colonel William J. Allen, Commander, Engineering Command.

Scale Model of Chemical Plant Seen As Potential Money Saver

ARMY CHEMICAL CENTER, MD.—The recently completed scale model of a chemical plant on display at the Chemical Corps Engineering Command here (part of which is shown in picture above) was built by the William M. Eichbaum Co. of Wilmington, Del., at a cost of $18,000. The model would be a valuable time and money saver should requirement for such a building become necessary, in the belief of Colonel William J. Allen, Jr., Chief of the Engineering Command, and project engineer Sebastian W. Kessler. Large industries have found that construction of scale models has proved valuable when need for full-sized buildings has arisen, according to Louis Garono, Engineering Command's Deputy for Engineering.

Showing a contracting engineer a model, as well as blueprints and specifications, will enable him to submit a more timely and accurate bid and get started on the construction sooner.

The model represents the latest concept in unit plant models by the Chemical Corps and uses the national color code for rapid identification of the many pipes, boilers, tubes and other fixtures. This standard color system is useful also in training operators.

The model is built on a sectional 9′x26′ platform consisting of several packing cases, into which the entire model can be placed in half a day for shipment as required. Everything from the largest boiler room to the smallest piping, represented by piano wires, is included, on the scale of ⅜″ to one foot.

This map shows the location of over 30 chemical plants now on the Ohio River including Columbia-Southern's plant at New Martinsville, West Virginia.
New Martinsville
West Virginia
OHIO RIVER
COLUMBIA
LIQUID CHLORINE
COLUMBIA-SOUTHERN

Pioneering America's Chemical River

A multi-billion dollar array of chemical plants has sprung up—chiefly in the last decade—along the banks of the Ohio River. Initiating this chemical boom in the upper Ohio Valley was Columbia-Southern's chlorine-caustic soda plant erected in 1943 at New Martinsville, West Virginia.

Many factors influenced the choice of this site—Columbia-Southern's geological research which confirmed the presence of huge salt deposits at practicable depths; plentiful supplies of West Virginia coal; the proximity to industrial centers; and, of course, the capacity of the Ohio to carry more than twice the tonnage handled by the Panama Canal.

The presence of a successful plant in an area frequently does more than anything else to attract others. Just as Columbia-Southern's Corpus Christi plant spurred the development of the great Gulf Coast chemical industry, so the New Martinsville plant sparked growth along the upper stretches of the Ohio. Today, from Pittsburgh to Paducah, the Ohio truly deserves the title of America's Chemical River, flowing unvexed to many markets.

This pioneering spirit pervades in every field of Columbia-Southern operations, producing continued developments and improvements in which its customers are first to share.

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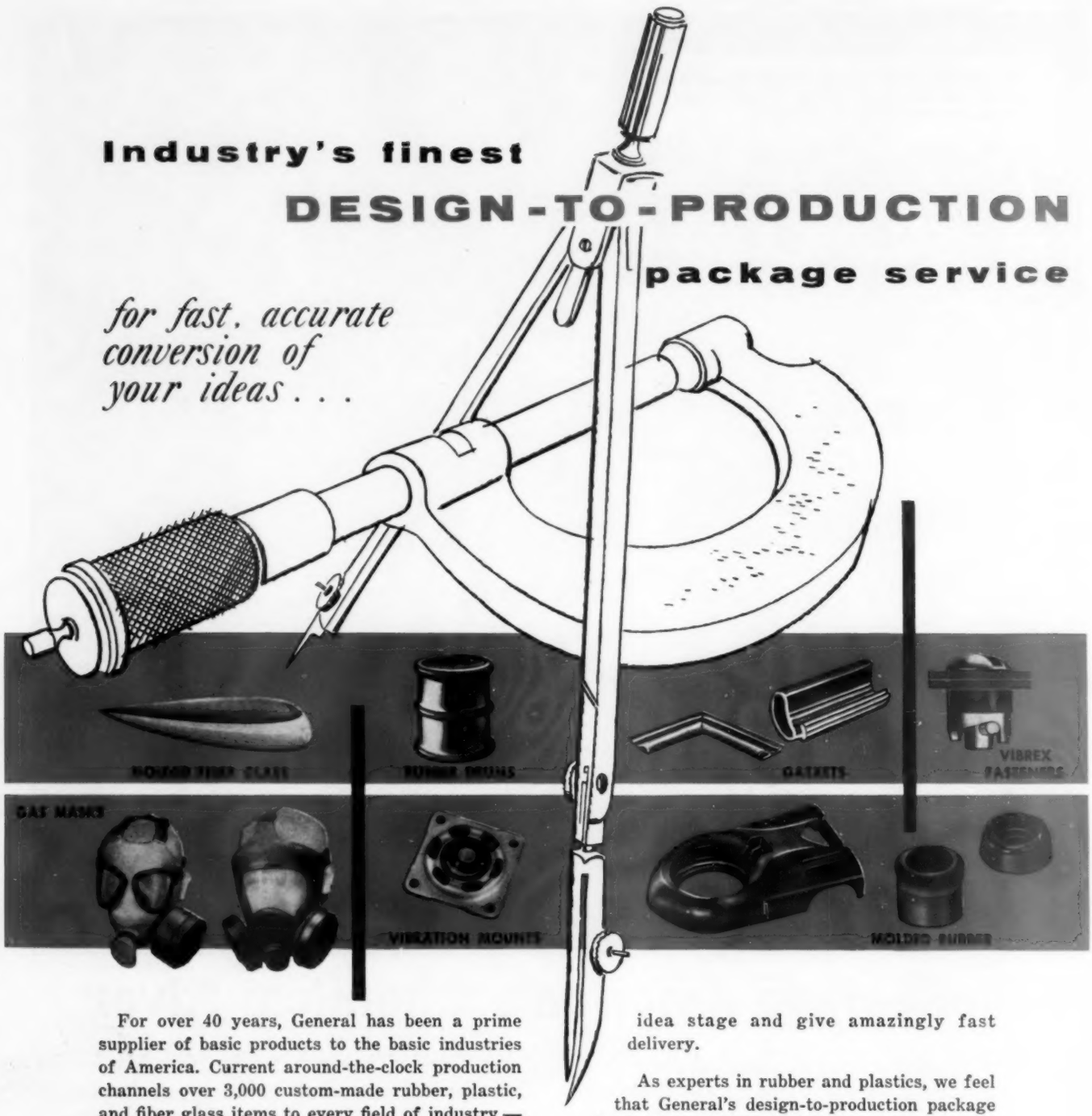

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